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THE PLANNING AND BUILDING OF INDUSTRIAL PLANTS.

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Mr. Day's articles—or, more specifically, the first two of the series here begun—are based upon a lecture delivered May 5, 1909, before the Graduate School of Business Administration, Harvard University. The mode of attacking, analyzing, and solving the problems of factory construction is so original, so thorough, and so valuable for general use that the series has been completed, at the invitation of THE ENGINEERING MAGAZINE, for wider presentation. As here presented, the original matter is revised, adapted, and very largely extended to cover the later phases of construction and occupancy.—THE EDITORS.

INDUSTRIAL plants have to do broadly with the manufacture of articles for commerce, and the problems that must be taken into account when building new plants relate to the use of machinery, the provision of shelter, the management of labor, and all other economic conditions that affect the manufacturing and marketing of the output.

It will be the purpose of this and the following articles to deal with the more important factors that compose these main headings; and as only a comparatively small group of men would be interested in the detail considerations presented by a given business, I will aim to convey the scope of the problem as relating to industries generally, and to point out the method of attack that is in any case necessary for its proper solution. Therefore, the discussion will have to do with matters that are, to some extent, common to the building of all industrial plants, whether it be one for the manufacture of machine tools or automobiles, for the preservation of food products or for making carpet or cement or pottery as the case may be.

Entirely new enterprises usually have a small beginning, manufacturing space being rented in a building that substantially meets

the requirements, or a small plant being built that would hardly come within the class of enterprises we have under consideration. Large industries are almost always the result of a gradual growth; so that, in the majority of cases, new machinery and buildings, if at all extensive, are either additions to existing plants or are provided for the continuance of a business formerly conducted elsewhere.

Until recently industrial managers were too prone to consider that the work incident to the building of plants and factories had no intimate bearing upon their future operation. They assumed that the degree of success attainable through conducting an industrial business depended upon the efficiency with which it was managed, and failed to appreciate the limitations that can be permanently imposed during the building period. This statement is borne out by the large number of concerns that have had to labor under excessive investment charges or adverse manufacturing condition, brought about possibly through the initial selection of unsuitable types of buildings, or because it was necessary to demolish good structures in order to make extensions, or on account of inadequate real estate for needed development, owing to the property having been improperly apportioned originally, or for other causes that will suggest themselves. The occurrence of one or more of these conditions is so usual that we must conclude that many industrial plants have been built without sufficient thought being given to existing and future needs.

Moreover, the subject is constantly assuming greater importance, owing to the phenomenal growth of the industrials in this country and abroad. Increasing confidence in their permanency is evidenced by the more general desire of administrators to provide adequately for the future, so there is now needed, in the building of industrial plants, a degree of foresight that former conditions did not often warrant. The building problem also becomes more complex as companies assume larger proportions (either as a result of development or consolidation), owing to the additional factors introduced when providing for a large amount of diversified machinery, and for the handling and control of large numbers of employees. Fortunately an understanding as to the exacting requirements of modern equipment and processes and of new systems of industrial administration and the desire to provide for the future has resulted in directing attention to the initial work incident to the building of new plants, and it is now more generally appreciated that the efficiency of any industrial establishment, in the final analysis, is governed to no small

extent by the effectiveness of the work done prior to the actual commencement of building operations.

Now as to the performance of this preliminary work, it was first assumed that those who were to operate a plant should advise the architect or engineer concerning the size, character, and internal arrangements of all buildings, and such factors as the selection and arrangement of machinery, facilities for receiving, handling, and shipping materials, etc. The supposition was that the experience required in order to pass correct judgment upon these matters was wholly outside the knowledge of those who were not directly engaged in the business in question. A marked change in policy, however, has been brought about largely by a class of administrators (the product of our large and scientifically managed industrials), who realize that they cannot hope to find, within their own specialized organizations, men possessing the broad experience and particular ability needed for the successful performance of all the diversified work required when building a new plant or making large extensions.

What I have just said will be more clear after consideration has been given to the classification of the subject appearing below. It will be evident that during the limited period needed for the designing of a new plant, almost every branch of engineering may be called into play, whereas the proper conduct of the routine work for which the plant is built may require little or no acquaintance with these. I am especially anxious that I should not be misunderstood in this regard. Those for whom the new plant is being built must in any event be counted upon to dictate primary requirements, but in the majority of cases their experience should be supplemented by the broader knowledge of others.

For the use of a better term, "Industrial Engineering" has been quite generally adopted as the name for the professional service rendered by independent engineers engaged upon such work as we have under consideration. Industrial engineers are not usually consulted until the decision to build has been reached. Such a decision is almost always followed by a desire upon the part of the principals to have the work completed at the earliest moment. This is but natural, as the need for greater facilities and accommodations for them is usually pressing. Therefore, the engineer engaged (as the owner puts it), "to prepare the building drawings," must accept as a basis much that the owner pronounces as satisfactory practice—and this is as it should be, for it is principally in regard to the broader considerations bearing on shop and factory layout that he can be of the

most service. However, the combined efficiency of a new plant is in any event dependent to a marked extent upon the experience and ability of those for whom the work is being done.

The planning and constructing of an industrial plant is essentially a one-man job, so far as control is concerned, but necessarily, owing to the diversified problems that are presented, the industrial engineer must have the support of not only his principals but of the engineering and commercial organization with which he is identified.

He co-ordinates the mass of technical matter turned in to him by the various engineers engaged upon his work, and on account of his intimate acquaintance with his client's needs, aims, and resources, he is able to consider the conclusions presented from a broad standpoint that is wholly unknown to the individual workers. A man acting in this capacity must know how to co-operate successfully with other men; to establish confidence in his methods through complete frankness as to his own or his organization's limitations; and to remember constantly that it is the final result that measures the usefulness of his efforts, and that it is absolutely immaterial from what source a given suggestion may come. It is this mental attitude that marks the successful industrial engineer, and the combination of a wholly impersonal attitude, coupled with the ability to take an aggressive position when conditions warrant it, is, as a rule, acquired only after considerable service.

As the engagement of industrial engineers is constantly becoming more customary, I will assume that this course is followed. By doing this, the part that the owner or operators must in any case contribute to the work will be emphasized, and it will be equally clear that the creative work of the industrial engineer has to do with such matters as are not usually included in the routine experience and work of owner or operator.

The classification of our subject that has already been referred to appears below. The main and sub-headings are only briefly described, but in the discussion that follows each of these captions will be taken up in considerable detail.

CLASSIFICATIONS OF WORK INCIDENT TO THE PLANNING AND BUILDING OF INDUSTRIAL PLANTS.

P.—Preliminary Service (Definition of requirements);
F.—Financing;
D.—Detail plans and specifications;
C.—Construction work and installation of equipment;
M.—Period of occupation and commencement of operation.

The principal subdivisions of the above headings are:

(P) PRELIMINARY SERVICE.

P-a. Ascertain the specific manufacturing requirements and compile data relating to present and future needs.

P-b. Ascertain fundamental principles that will be followed in new plant regarding the administration of all manufacturing details.

P-c. Consider features exemplified by plants recently built for essentially the same class of work.

P-d. Determine kind and amount of machinery that should be provided for immediately.

P-e. Decide upon geographical location of site and whether plant should be built in business centre or suburban section.

P-f. Decide preliminarily upon arrangement of equipment and processes based upon elemental routing and administration requirements.

P-g. Determine floor areas required for manufacturing departments, storage departments, assembling departments, offices, etc. Also likely future requirements.

P-h. Determine which departments *must* be accommodated on the ground level and which *may* go on upper floors.

P-i. Determine railroad and trucking facilities that should be available for receipt and shipment of materials.

P-j. Determine total property area needed at once, and amount that should be reserved for the future.

P-k. Select property that most nearly meets the requirements dictated by study of foregoing factors. If possible it is preferable to defer purchase until completion of preliminary work.

P-l. Prepare alternate layouts of departments, segregating them into one or more buildings of assumed types, taking into account all the foregoing factors including the selected property.

P-m. Reconsider all work done so far and prepare a revised layout incorporating as far as possible the best features of the various preliminary studies. Make out line drawings of buildings.

P-n. Prepare a classified estimate of cost based upon unit prices.

P-o. Determine whether estimated expenditure would result in a "fixed charge" consistent with the probable profits of the business, i. e., can the business carry the necessary investment?

P-p. Determine whether owner is prepared to make the total justifiable expenditure.

P-q. If financial limitations (P-o or P-p or both) require it, revise the layouts and prepare data and plans suitable as a basis for the preparation of architectural and engineering plans.

(F) FINANCING.

We will assume that the owner personally provides the necessary funds and is not assisted in any way during his negotiation therefor by the industrial engineer. This is the usual condition in connection with the building of industrial plants.

(D) Detail Plans and Specifications.

(To meet requirements defined by the preliminary work.)

D-a. Prepare plans and specifications for special machinery as defined by preliminary work.

D-b. Prepare plans and specifications for all other physical features defined by the preliminary work.

D-c. Prepare plans and specifications for power generating, transmission, and driving equipment to meet the established requirements.

D-d. Prepare plans and specifications for equipment needed to provide artificial lighting in accordance with fixed requirements.

D-e. Prepare plans and specifications for ventilating and heating equipment needed to meet fixed requirements.

D-f. Prepare plans and specifications for sanitary arrangements needed to meet fixed requirements.

D-g. Prepare plans and specifications for fire-prevention apparatus based upon the conditions established by the preliminary work.

D-h. Prepare plans and specifications for the complete building or buildings, so prepared as to harmonize with the plans and specifications covered by headings D-a to D-g inclusive and to meet requirements defined by preliminary work.

D-i. Prepare plans and specifications for yard provisions that must be made to meet fixed requirements.

D-j. Prepare contracts to accompany plans and specifications when soliciting bids, so drawn as to provide proper protection for both the owner and contractor.

(C) Construction Work and Installation of Equipment.

C-a. Select responsible concerns to bid upon plans and specifications and secure bids from such parties.

C-b. Tabulate bids, confer with Owner, followed by placing of contracts.

C-c. Superintend building construction and yard work.

C-d. Superintend installation of "service equipment" and all standard and special machinery or appliances needed for industrial purposes.

C-e. Check work as to quality and amount and approve invoices.

C-f. Certify as to completion of contracts.

(M) Period of Occupation and Commencement of Operation.

M-a. Move equipment and accessories from old plant into the new, transfer force, and start up work.

M-b. Correct minor discrepancies that invariably evidence themselves after the plant as a whole is put into operation.

M-c. Train the force of administrators and operators along the lines necessary to bring about the most efficient utilization of the buildings and other facilities provided.

(P) Preliminary Service.

P-General.

While it is clear that each of the factors listed above under "Pre-

liminary Service" has a bearing upon the building of industrial plants, irrespective of the nature of their output, it must not be overlooked that their relative imporance is governed wholly by he purpose and conditions of each particular business that is taken under consideration, and the governing factor in one case will assume only a minor part in another. In one business the governing motive may be publicity, and the need of effecting economies in processes of manufacture may be unimportant, as is illustrated by certain of the patent-medicine companies. In another case the advertising problem may be automatically solved through the attainment of a product of the highest standard, as is exemplified by the business built up by the Herreshoff Manufacturing Co., designers and builders of boats, and the work conducted some years ago by Alvan Clark, whose telescope lenses were of such superlative worth that they were sought from all parts of the world. In these instances everything is sacrificed to quality and a standard of product is attained that practically eliminates competition. The majority of industrial plants, however, are supplying to the market articles subject to close competition, and quality of output, economy of manufacture, and sales effort, are matters of almost equal consequence. This phase of the subject should be constantly in mind during the explanation that follows, for it cannot be emphasized sufficiently except by taking up the detail consideration presented by a given industrial plant.

P-a. Ascertain the specific manufacturing requirements and compile data relating to present and future needs.

I have stated that new buildings and machinery for industrial purposes, if extensive in character, are almost always provided for those who are already engaged in the line of business that is to be accommodated, so that the preliminary work commences with a study of the existing methods and facilities and a knowledge of the purposes that have prompted the building work.

It can be properly assumed that the fundamental reason a given organization is engaged in a certain business is the familiarity of its members with the requirements of the trade supplied. Such knowledge is the main asset of those engaged in industrial work, so that they are necessarily best able to define just what the plant is to manufacture and what its output shall be. Therefore, the industrial engineer must look to his principals for advice in this regard.

Every large business has one or more men who devote all or part of their time to the study of the principal matters coming under

the first heading of "preliminary service;" and changes in processes, the installation of new equipment or apparatus, and the rearrangement of machinery or departments are constantly going on. The articles comprising a large part of this Magazine's publications bear witness to the enormous amount of investigation and planning that is necessary to keep abreast of the times in even a comparatively narrow field of industrial work.

The selection of equipment types and processes is obviously at the root of economical production, so constant study must be made of these subjects to keep reasonably up to date. Betterment of methods usually is attained only after much time and money have been expended, and it is manifestly the province of those who are directly engaged in a given business to institute research work of this character. The development of methods and processes incident to the manufacture of almost any line of output illustrates the condition to which I have just directed attention. For example, the present method of forming the felt body of the Derby hat, or the process now used in making the printer's matrix, or the determination of the composition and treatment of steel for an efficient automobile spring, have been brought to their present high efficiency only after years of painstaking work, and further advances will undoubtedly come slowly and are likely to entail large expenditures.

Obviously the services of the industrial engineer should not be expected to contribute materially to these fundamental industrial problems which are special to each individual industry. They comprise that part of the knowledge needed when building new plants which must, in the majority of cases, be contributed by those directly identified with the business for which provision is to be made. But the industrial engineer must thoroughly familiarize himself with the machinery, methods, and processes in use in the existing plant, for it is this information which will form the basis for his subsequent work. It is of the utmost importance during this period—and, in fact, throughout the time that he is engaged upon the work—that he be accorded the full co-operation of the owner and his people, although the engineer should be expected to take the initiative. This is a matter that is of equal importance to both parties, for while the industrial engineer needs the advice of his principals, the latter should be conversant with the work he is doing, especially after the preparation of departmental and building layouts has been commenced. It is always easier to secure the approval of a given plan by discussing it from time to time as the work goes forward, and when this is done

the anticipated efficiency of the completed plant is much more likely to be attained, as the purpose of the various provisions that have been made is properly understood in advance.

The preliminary investigations of the engineer will, however, cover a great many matters concerning which his principals have little or no reliable knowledge. These comprise the factors which, in a certain sense, are incidental to the specific manufacturing work, such as the power and lighting requirements, heating and ventilating requirements, sanitary requirements, care of employees, and the requirements imposed upon the building structures by the work in question. With the possible exception of the power and lighting problems, these matters are in the majority of cases only partially understood by those who manage industrial plants, and we should not expect to find it otherwise.

Throughout the period that the foregoing subjects are under investigation the engineer should make complete and systematic notes, and in many cases the data that he secures can be advantageously reduced to unit bases—such as the floor area per operator in different departments, or the floor area per ton of finished product, the power consumption per square foot of floor area needed for artificial lighting and, in some cases, for power in different departments, and so on. It is in regard to details of this kind that the competent industrial engineer has a great advantage over men who are not constantly engaged in this field of work, for he adheres to a definite plan of procedure that has been ascertained after repeated modification and amplification, so that each factor is taken up in its proper sequence and no important detail is overlooked.

P-b. Ascertain fundamental principles that will be followed in the new plant regarding the administration of all manufacturing details.

The engineer must have, in addition to the information just covered, complete notes concerning the plan that will be followed in the finished plant for the administration of manufacturing work, for this is a matter that may have a very decided influence upon the arrangement of machinery and departments, and it is the basis for arriving at an office layout, including the clerical offices located throughout the shops. Therefore it is necessary for the engineer to be conversant with the fundamental principles entering into the different systems of shop management, if for no other purpose than to know how to provide properly for the system that is prescribed.

In order to illustrate this point, I will call attention to the fact that the selection of machine-tool equipment for a metal-working

plant employing a system of administration such as is advocated by Mr. Fred W. Taylor, would prove to be quite a different problem from that which would be the case if the machines were installed where no instruction cards were issued and the men were guided almost entirely by their own experience.

Not infrequently the industrial engineer is able to designate to his principal with such clearness the advantage that would accrue through a modification in his system of management, that the latter will adopt his recommendation and agree to have the physical layout prepared in accordance therewith. For example, a system requiring a double-bin store room necessitates that considerably more floor space be given up to this department than would be the case if single bins were used. If the former plan is desirable, it is quite important that this decision should be reached at the commencement of the work. The tool-room system that is to be followed in a large metal-working establishment must be considered when making the individual department layouts, if the best results are to follow, and the system of checking employees in and out of industrial plants is a determining factor when providing entrances and exits.

Occasionally the owner desires a certain amount of latitude provided in the layout, so that he may be able to depart in certain particulars from the prescribed plan. The extent to which this is possible depends almost entirely upon the character of the output. A great deal of industrial work is performed upon machines, or necessitates the use of processes, which can readily be housed in standard factory buildings that need not be designed with particular reference to the requirements of isolated departments, whereas in other cases the buildings must be wholly special in character, and to a certain extent should be considered as a part of the necessary equipment.

P-c. Consider features exemplified by plants recently built for essentially the same class of work.

The information secured under the headings P-a and P-b, after being recorded, forms the basis for the layout of the new plant or extension, but it should be supplemented with general data concerning the practices that have been followed by others when building plants for essentially the same class of work. It is in this regard that the services of a properly equipped engineering organization should come prominently into play, for in addition to their own experience they should have for reference a complete statistical department where the desired facts could be readily obtained. Reference should not be made to these records until the owner's practices and views

are fully understood, and in any case much care must be exercised in the selection of features that have been adopted by other concerns, because they have been frequently dictated by special requirements that are not evidenced during a casual inspection.

P-d. Determine kind and amount of machinery that should be provided for immediately.

The machine equipment and apparatus for process work should now be decided upon. In most instances the list comprises a certain amount of machinery formerly used elsewhere, together with additional equipment which may be for the purpose of increasing the output or for the greater efficiency made possible through its use. The probable equipment requirements for the future should also be approximated, as this governs the amount of floor space that it should be possible to secure by further extensions. The owner and engineer are frequently confronted with the need of providing equipment for the manufacturing of certain articles in large quantities, which had been turned out previously only in small lots. In such case, after the output of a given type of machine had been ascertained the cost of operation must be carefully figured, taking into account all fixed charges. Other available types of machines should be considered in the same manner, but as was previously stated matters of this kind are usually worked out by the owner prior to the commencement of work bearing upon additional accommodations and facilities.

Sometimes complete freedom of choice is permissible when determining the machinery or processes that shall be used, whereas under other circumstances collateral conditions must be taken into account. I have in mind a certain industry where the labor union dominates its members to such an extent that for the present, at least, they are successful in prohibiting the use of particular machines, or if they are used, the rate of wages per piece must be substantially the same as for performing the work in accord with older methods.

The point has now been reached when the department layouts can be worked up as a preliminary step leading directly to the arrangement of departments within given buildings and the determination of building types. When this has been done the necessary property area can be arrived at, the site selected, and the final grouping of buildings decided upon. These and all other matters covered by subdivisions P-e to P-q inclusive, will be considered in further detail in the following papers, where the remaining sections of the work will be treated.

THE SUBSTITUTION OF ELECTRIC POWER FOR STEAM ON AMERICAN RAILROADS.

By F. Darlington.

One of the greatest living authorities on electrical engineering, who has seen Mr. Darlington's article in manuscript, calls it a most original and satisfactory discussion of the subject. We are glad to present it in THE ENGINEERING MAGAZINE at a time when the electrical operation of steam railways gives so much evidence of new and wide extension. —THE EDITORS.

ONE frequently hears the popular prediction that in five or ten years, or in some other period, all of our railroads will be using electricity in place of steam engines. Are there sound grounds for this belief? Will electric power be generally adopted in place of steam for hauling trains? What are the conditions that will control the application of electric motive power? Involved in the whole matter are questions of economy, utility, habit, prejudice, and the policy of railroads. Local factors affect the results very widely in different sections and the attitude of legislation towards railroads is becoming a factor.

For brevity, American practice will be here considered without much reference to foreign developments.

REASONS FOR USE OF ELECTRIC MOTIVE POWER ON RAILROADS.

Electricity is used on railroads under two conditions:—where it is necessary for cleanliness, comfort, and safety, largely irrespective of the economy of its use; and where it is used for its economical advantages. It is used for convenience and cleanliness in tunnels and on city terminals of a few large railways. Where it has supplanted steam in such cases, it has demonstrated its economy compared with steam on an operating basis, but in some instances questions of economy are still open when the fixed charges on the electrical installations are considered. It is safe to say, however, that no large electrical equipment has been installed where steam engines were formerly operated in which electricity has not accomplished results that could not have been secured by steam.

ELECTRIC MOTIVE POWER USED FOR ECONOMICAL ADVANTAGES.

The use of electricity where it has been applied to railroads for purely economical reasons is confined mainly to interurban trolley roads and to city street-car lines. City street-car lines are omitted

from consideration in this discussion, except as city street cars affect terminal conditions in large cities, since they are only secondarily involved in the more general problems of transportation.

In addition to its present extensive use for city railroad terminals and railroad tracks in tunnels, there are a few instances where electric motive power has been substituted for steam for the purpose of increasing earnings and securing greater comfort and convenience. Instances of this are the partial change to electric power on the West Jersey & Sea Shore Railroad from Camden to Atlantic City, on the Rochester division of the Erie Railroad from Rochester to Mount Morris, and on the steam railways from Baltimore to Annapolis, and in some other sections, and these substitutions have all been highly successful.

The introduction of electric power made interurban roads possible and led to their extensive development for local traffic between cities and along populous routes. Steam railroads did not avail themselves of electric motive power, and hence fail to supply the needs of transportation that are being met by trolley roads. These interurban roads are practically the outgrowth of city electric street-car lines and they employ much the same type of apparatus and methods of operation as the city lines. Interurban roads have been built only in places where the conditions are favorable to their operation, and these are few.

Two Classes of Electric Interurban Roads.

An examination shows that practically there are two classes of interurban roads—the roads of the New England States and New York State and Pennsylvania, of one class, and the roads of the Middle Western States of another class. The distinction, and it will become important in the future, lies primarily in the location of the tracks and in the grades and curves. The trolley roads in the Eastern States are built mainly in hilly countries, on highways and streets. Their grades are usually high and cannot well be reduced, since it is not often feasible to make heavy cuts and fills on highways, and the curves are sharp on account of the turns on highways and streets. In the thickly settled counties of the Eastern States it is difficult and expensive to obtain private right of way for trolley roads, and consequently their tracks are generally bound to follow highways, and will be suitable for their present service—that is, for local traffic, passengers, mail and express, but for little else.

In the Middle West electric roads are generally built on private right of way, excepting for short distances where they pass through cities and villages. They are on low grades and their roadbeds,

bridges, etc., are built largely to steam-railroad standards. A great part of their mileage directly parallels steam railroads, and when they do not follow steam lines they sometimes follow the county or township section lines which in the West are laid out straight. By following these lines they traverse the country between farms without going through them.

ESSENTIAL DIFFERENCES BETWEEN INTERURBAN ELECTRIC AND STEAM RAILROADS.

For terminals, trolley roads use mostly the city streets, with a few instances in some of the Western cities of central buildings or sheds for exchange of passengers and packages. For the business that is done by trolley roads, stops on city street corners are vastly more convenient than railroad station stops.

The practical difference between trolley roads and steam roads in the Middle West lies almost wholly in the kind of city terminals they have, the motive power they employ, and the kind of business to which they cater. Up to the present time trolley roads have confined their attention almost wholly to passenger business, but Western trolley roads are physically suitable for doing much local freight work; their conditions justify it and they will more and more enter the general railroad field, especially in level countries.

EXTENT AND ECONOMY OF INTERURBAN ROADS IN THE MIDDLE WEST.

In the three Middle Western States, Ohio, Indiana and Illinois, there were in 1907 about 5,000 miles of such interurban roads, earning annually about $26,000,000 gross, and having a combined stock and bond capitalization of about $400,000,000. Many of the adjoining States, as Wisconsin, Michigan, etc., also have large mileages of interurban roads in operation.

The most trustworthy judgment of the economy of using electric power on railroads can be had from results that these Middle-West interurban roads are accomplishing. In the three Middle Western States, Ohio, Indiana and Illinois, where the total mileage of electric interurban railroads was about 5,000 miles in 1907, the combined steam-railroad mileage was about 28,576 miles, or the trolley-road mileage was 17.6 per cent of the mileage of the steam roads. About 85 to 90 per cent of the trolley-road mileage is in direct competition with steam railroads between cities, and about 75 to 80 per cent of the trolley-road mileage directly parallels the tracks of the steam railroads, competing for local as well as interurban traffic. The gross earnings of $26,000,000 per year total for the interurban trolley roads in these three States are about $5,200 per mile of trolley road per year average. This business is derived almost wholly from carrying pas-

sengers, a very small portion of it being from freight, mails and express, and miscellaneous sources. The annual gross earnings of the steam railroads in the same States are probably about $430,000,000, of which about $97,000,000 is derived from passenger and mail and express business and the balance from freight and miscellaneous business. From this it will be seen that though the gross earnings of the trolley roads in these three States are only about 6 per cent of the gross earnings of the steam railroads, they are about 27 per cent of the gross passenger mail and express earnings of those railroads.

Traffic Controlled by Electric Railroads.

Electric lines form an essential link between main-line railroads and their customers, so the business of electric lines is important in the general scheme of transportation in a larger proportion than the ratio of its volume to the total business done. The traffic of electric roads originates upon their own lines and to a great extent is created by them. They receive it at first hand from the customers, so that it comes to them without direct competition, and is very little affected by rates made by opposing companies or by rate pools. Trolley roads are now serving as feeders to collect traffic, and as their importance grows they carry this over longer and longer distances and get a more and more complete control of transportation from its origin to its destination. The value of feeders and branch lines in large railway systems has always been recognized, and many branch lines that are unprofitable in themselves have been built and operated for the business that they create and bring in to main lines. This necessitates local service, and this is the field in which interurban electric roads are now working and in which electricity has shown one of its chief advantages over steam.

If fifteen years ago the officers of the large transportation systems of the United States had been told that electric railroads would enter the territory covered by their tracks, would closely parallel them and usurp their local business, they would have considered the fulfilment of the prediction unlikely, to say the least. If they had then foreseen the present situation, it would have been considered a serious menace to their operations, as indeed it has become, and the menace will increase if conditions are not wisely met. To meet the situation it will be necessary for the steam railroads to employ electric power for those kinds of transportation work in which its superiority over steam has been demonstrated by trolley-road developments. Wherever there is a considerable local traffic to be handled, trolley roads have proven the superior economy of electric service; and in such sections steam roads must eventually adopt electricity for conducting local traffic.

ELECTRIC RAILROADS GET THE BEST TRAFFIC AND LEAVE THE POOR.

There is one element in the interurban electric-road business to which attention should be given—that these roads are not competing with the steam railroads for the local business in the sparsely settled and unprofitable parts of the country, but in the richest and best and those most productive of receipts from local transportation. The 5,000 miles of electric road in Ohio, Indiana, and Illinois take their trade from the heart of the local passenger business of the steam railroads.

An often reiterated though scarcely fair statement has been made by many steam-railroad men, that their passenger business is unprofitable and that they would be glad to be rid of it, that they can make no money in it, etc. Even granting for the sake of argument that such a general statement is true, it really does not apply to the business acquired by the trolley-road companies. The trolley roads parallel steam railroads only in the best of their territory; and following (in the well populated States) say 20 per cent more or less of their lines, they take away the best part of the passenger business, which in itself would undoubtedly be profitable if the steam roads could retain it without the more scattered outlying passenger traffic that has to be collected over a very large reach of track. The net result to the steam roads is that their passenger business is more scattered, since the heart has been taken from it, and it must be more costly to operate in proportion to the return earned, since the traffic density has been reduced.

Electric interurban roads go only into the richest and best territory which has been previously served by steam railroads, but they do not depend for their profit strictly or mainly on the traffic they take away from the steam roads. While there is a certain kind of business that deserts the best steam-railroad accommodations for trolley lines, there is a potential business in every populous country that is developed by the trolley roads but is not available to steam roads. The accommodations that trolley roads offer build up traffic both by inducing travel from existing sources and by developing the territory along their lines and attracting additional population and new enterprises. Steam railroads feel the benefit of this new business in their through traffic, and sometimes suffer no net loss even where their earnings from local and short-haul business fall off heavily; but from the trunk-line railroad point of view, even such a situation is not reassuring since the condition is certainly unstable as long as the trolley roads maintain independence and as long as they show a profit and continue to extend their mileage.

In the case of the trolley roads of the Middle West, for the reasons that I have already stated, there are no set conditions that will limit their extension and their entrance into new lines of business, including longer hauls, the haulage of freight, etc.; and as long as they possess, as we have seen they do, the power to originate and create new business and at the same time take established local businss from steam railroads, they hold the key to the non-competitive trade, and when their extensions carry their termini into competitive points they will be in position to offer the business that goes beyond their lines to the lowest bidder.

Electric Roads Superior for Local Service.

The superiority of trolley roads for local service constitutes their greatest advantage over steam lines. It results from the frequent service that they conduct, the convenient stops that they make, and the accessibility of their tracks to passengers and shippers.

The accessibility of trolley roads is secured largely by the use of city streets for terminals. A managing officer of a large Western railroad in conversation with me recently emphasized the importance of this arrangement by saying that its convenience to local travelers gave the trolley roads such an advantage that nothing that steam railroads can do would offset it, even to the buying of the trolley roads themselves, unless the steam railroads at the same time bought up the city and town street-car lines over which the interurban cars entered the towns; "For," said he, "if we buy the interurban roads and do not control the terminals, new trolley roads will be built, paralleling the old ones and using the city streets for terminals."

It is, perhaps, going a little too far to say that the present trolley lines would be paralleled. They would be paralleled only in case the present accommodations are reduced, but the manager knew whereof he spoke when he emphasized the importance of convenient terminals secured by entrances on city streets, which are far more convenient for local travel than the most costly station terminals of steam railroads. A traveler, especially for a short trip, would rather take a car on the nearest street corner than go a few blocks further to the most elaborate terminal station. Similarly the local stops, or, as they are called, flag stops, on the rural sections of interurban trolleys are a source of great convenience and therefore of greatly added travel, and this is supplemented by the convenience of the more frequent trains operated by rural interurban roads than by steam roads.

Cost of Frequent Train Service.

The economical conditions determining the best frequency of service are entirely different on electric roads and on steam roads.

The former operate single cars with apparatus and equipment that is especially designed for quick and cheap single-unit operation. A comparison of the operating expenses and earnings of nineteen interurban electric roads in Illinois shows the average operating expense on these electric systems to be 15.8 cents per car mile. This average cost is divided about as follows:

Electric power	3.73	cents
Operation of cars	5.40	"
Maintenance of cars and equipment	1.30	"
Maintenance of roadbed, overhead lines, and buildings	1.70	"
General expenses	3.67	"
Total as above	15.80	cents

Steam railroads operating trains are put to a much higher cost per train mile. Each steam train consists of a locomotive with an engineer and fireman, and coaches with a conductor and brakeman, against a crew of a motorman and conductor on a single electric car. The rates of wages on the steam trains are higher than on electric cars, and steam locomotives are more costly to maintain than electric car apparatus; in fact, the motive-power cost alone of steam-railroad service per train mile generally far exceeds the total operating cost per car mile for electric roads.

The cost of operating light local steam-railroad trains, without including the maintenance of the roadbed and the wages of station attendants and the general expenses of the railroad, usually comes to $0.40 to $0.60 or more per train mile.

The same nineteen interurban electric railroads in the State of Illinois mentioned above make gross earnings per car mile about $0.295, or say roughly their gross earnings are only about two-thirds of the actual cost per mile of operating light steam trains.

It may seem at first sight that it is illogical to compare the cost of operating a single electric car with the cost of operating a steam-railroad train, but for practical results this is the way to make the comparison for local interurban business. Trolley roads generally charge between 1½ and 2 cents per passenger mile, and their cars have a seating capacity of 45 to 60 passengers. Their earnings for a general comparison may be taken at about 27 cents per car mile and their operating expenses at 16 cents per car mile.

Yearly Earnings of Interurban Roads.

The gross earnings per mile of track per year of the same nineteen trolley roads previously mentioned average about $6,700 for the year 1906-1907, which is a good average for prosperous electric

roads in Illinois. The average gross earnings of all the interurban trolley roads reporting to the State Commissions of Illinois for the same period (representing 1,092 miles) was $6,230 per mile per year.

The gross earnings per mile of track per year of ordinarily successful trolley roads lies between the limits of $4,000 to $7,000. The operating expenses average about 60 per cent of the gross earnings, which deducted from $4,000 or $7,000 a year gross earnings leaves a net earning per mile of track of about $1,600 to $2,800. This is a fair statement of the showing of average successful interurban roads.

RELATIVE EARNING CAPACITY OF TROLLEY CARS AND TRAINS OF CARS.

With fares on trolley cars averaging as stated, 1½ to 2 cents per passenger mile, the average occupancy of a car to pay 27 cents is only in the neighborhood of 15 or 16 passengers.

A rather complicated question arises here as to the relative earning value of a steam-railroad train with two or three coaches and a trolley car with a seating capacity of 45 to 60, but in places where the trolley-road earnings are made from an average occupancy of less than half the seating capacity of the cars and where frequent service is necessary in making these earnings, it would obviously be unprofitable to haul trains of three or four cars to carry the passengers. If there is sufficient travel to overload the ordinary interurban car, it will usually be profitable to increase the frequency of the schedule, since an increase in schedule will stimulate further travel and can be made at an operating cost per car lower in proportion than the 16 cents assumed as an average figure, since that includes maintenance of track, maintenance of trolley, general expenses, and other items of cost that do not increase in direct proportion to the number of cars in operation.

NECESSARY MINIMUM EARNINGS FOR PROFITABLE TROLLEY DEVELOPMENT.

Interurban trolley-roads producing average net earnings per year of about $1,600 to $2,800 per mile of railroad would return about 6.4 to 11.2 per cent on an investment of $25,000 per mile, or about 5.3 to 9.3 per cent on an investment of $30,000 per mile. Where conditions are favorable, interurban trolley roads have been built and equipped (especially in the Western States where there are not many bad hills or costly bridgs) for about $25,000 to $30,000 per mile of road, averaged approximately as tabulated on page 908.

From these figures may be determined very roughly the lowest returns under which interurban electric roads doing local business can be made profitable. When analyzed they show that the return on their cost must be small where the gross earnings per year are less

AVERAGE COST OF ELECTRIC RAILWAYS IN THE MIDDLE WESTERN STATES.

For Roadbed.	Cost per mile
Grades and bridges	$ 5,000
Ballast	3,000
Ties	1,200
Surfacing	500
Steel	4,000
Right of way (variable)	1,000
Add for general expenses, say	1,500
Total cost of roadbed per mile of track	$16,200

For Cars and Electrical Equipment, Power Plant, Substations and Feeder.

	Cost per mile of track
Cars and equipments, $1,000 to $2,500; about	$ 1,200
Power plant, $1,200 to $2,400; about	2,200
Transmission lines, transformer stations or substations, feeder cables, etc., $1,500 to $4,000; about	3,000
Trolley, etc.; about	1,600
Add for general expense engineering and interest per mile of track; about	1,000
Total for power plant, cars, transmission lines, etc., per mile; about	$ 9,000
Total cost of trolley-road construction, power plant, and equipment, per mile of track; about	$25,000

than $3,000 or $4,000 per mile of track, or the net earnings less than $1,800 to $2,400 per mile, and independent trolley-road investments will not be attractive with smaller earnings except under exceptionally favorable circumstances. Experience has taught that trolley roads parallel to steam railroads generally realize these earnings wherever the gross earnings from local business of the steam roads prior to the commencement of operation by the trolley roads were from $1,000 to $2,000 per mile per year. The trolley roads, by reason of their superior convenience, take from the steam railroads and create enough business to make up the necessary total. Often instances occur where the increase of the trolley-road earnings over the steam are much greater than stated by these figures, and again there must be instances where they will be less. I give them only to point out in a general way about where the field of the independent electric interurban trolley road ends. Their profitable extension ends in the countries where the earnings from local service will not pay a profit on an investment of about $25,000 per mile of road.

STEAM RAILROADS CAN MAKE LARGE PROFITS.

The adoption of electric motive power on steam railroads, and the maintenance of a convenient and frequent service where there is a considerable local business which can be handled advantageously with electric cars, will result in a handsome increase in their earnings.

The opportunity of steam railroads for this kind of work is in many places much better than that of independent trolley lines. In

the first place, steam railroads have existing right of way, bridges, stations and station attendants, all of which are indispensable to them in connection with their through business which, up to the present time, has been very little encroached upon by electric roads. Furthermore, steam railroads as a rule have far better facilities for raising money for development purposes than electric roads. The latter usually sell 5 per cent bonds to raise the money for their construction work and receive from these bonds about 85 per cent, more or less, making the fixed charge on their cash investment about 6 per cent. They have all the expense of independent organization and management, both for construction and operation, to which are added generally large promotion charges. Steam roads, with their established organizations, with the lower interest cost for the money that they spend, and with their right of way already owned, can build and equip electric lines to the best advantage. Furthermore, steam railroads establishing an electric service on their lines could utilize their present tracks to a certain extent for electric cars, as standard electric-railroad apparatus, which in no way interferes with the operation of steam trains over the same tracks with electric cars, is regularly manufactured and sold. An electric schedule on a steam railroad will permit the entire discontinuance of steam trains for local passenger and local freight and express. Experience has demonstrated that local freight can be handled more cheaply with electric motive power than by steam. A properly equipped baggage, freight, and express car, with standard couplers and with motors properly adapted for high tractive effort at low speeds, is suitable for hauling a considerable number of freight cars as trailers.

In some recent calculations for a steam railroad where the cost of handling the local freight business is well-known, the cost of handling the local freight by steam is 54 cents per train mile. The same work could be done with a motor car using electric power costing 1 cent per kilowatt hour for about 22 cents per train mile, which would be a saving in local freight operation of more than one-half.

A large railroad having a terminal in Chicago with one of the heaviest suburban services in America, or in the world for that matter, and with an exceedingly large freight-terminal business in Chicago, is making a careful study of the Chicago end of its line. It is examining with the utmost care the commercial as well as the engineering side of the electrification problem and is studying the results it could get in the different kinds of work to be done.

It has not announced its conclusions resulting from its study, but certain features of the proposed work are apparent, *viz:* the

local or suburban passenger business can be handled rapidly and economically with electric equipment; the through business, both passenger and freight can be handled with economy and certainty by electric power. The through freight business, because the trains are heavier and slower than the through passenger trains, will realize smaller economical advantage from electrification than the passenger business.

STEAM RAILROADS CAN BEST SERVE CITIES WITH INTERURBAN CARS.

Steam railroads, to get the full benefit of electric operation, ought to secure the same terminal convenience and the consequent advantages that interurban electric roads have. At first sight this appears difficult, as popular prejudice is against giving steam railroads the same privileges as electric roads for moving cars through cities and villages, even if the steam railroads agree to use electric power on the streets. This discrimination is purely a question of public prejudice and should be overcome, since steam railroads having tracks on private right of way reaching generally well within city limits require relatively short distances on city streets to reach the populous centres. The entrance of trolley roads to cities almost always necessitates a long course over several blocks or several miles of city streets, which means an annoying and dangerous occupancy of the streets and relatively long stretches of slow-speed movement for interurban trolley cars. Steam railroads, on the other hand, having terminals reasonably near to the city centers, could (if they were granted the privilege) run electric cars from the nearest point on their steam-railroad tracks, directly to the populous centers, occupying the streets only for the distance from their tracks to the populous centers and returning their cars to their own line by the same route or by a short loop. In this way the mileage of city streets encumbered by interurban electric service if furnished by steam railroads would be much less than that ordinarily taken by independent trolley roads; and the distance being shorter, the incentive would be less to run at high speed through the city streets and the danger would therefore be reduced.

For the larger cities, such as New York, Philadelphia, Chicago, St. Louis, and perhaps a few others in the United States the problem of trolley road terminals is entirely different from the one presented in the small cities and villages. For example, for an interurban car to enter the populous center of Chicago by the streets requires a long and slow passage over many city blocks. In such cities where the distance from the outskirts to the populous centers is great, the question of entrance requires special consideration for each case and can hardly be generalized upon. If generalization is worth anything, the

statement of the case would be that the entrance should be made mainly on private right of way, which of course is practical only to lines doing a large business, like the existing steam lines, and the collection of passengers to the terminal points of steam railroads in the large city centers is generally properly the function of the street-car lines.

Electric Power on Railroads, and State Laws.

Public sentiment and the policy of American legislatures may have an important bearing on the wisdom of steam railroads adopting electric power. There has been inconsistency in the action of legislative authorities in some of the most advanced States governing competition between railroads. State legislatures, through the authority of commissions and the courts, are controlling railroad competition. If a railroad is to be built in a State where a railroad commission rules, application must be made to the commission and reasons given why a new railroad is required for the country where it is contemplated. If the commission finds that the territory is already provided with ample railroad accommodations, it will refuse to grant a new franchise to a steam railroad. The position is taken that one railroad with ample facilities for a given territory is sufficient, and better than two railroads where no advantage can be expected to result to the population affected and where competition between two lines would tend to make both the systems unprofitable.

Properly administered this is undoubtedly a wise policy, where the commission will determine and enforce ample transportation facilities and reasonable rates.

The New York Public Service Commission in March of this year voted not to grant an application of the Buffalo, Rochester and Eastern Railroad for a franchise to build a railroad in general paralleling the New York Central and Hudson River Road between Buffalo and Troy. The rulings of the commission in this instance were based on grounds of public utility, and this single example will serve to exemplify the policy.

The same rules are not consistently applied to competition of electric roads with steam roads.

In Massachusetts the courts last year ruled that the New York, New Haven and Hartford Railroad could not own or operate electric roads. The electric roads involved, it must be remembered, were often directly and closely parallel to the New Haven Railroad's tracks and were built as direct competitors to the latter. And yet this same commission would undoubtedly have ruled against granting a fran-

chise to build a steam railroad paralleling the tracks of the New Haven.

Why should legislation prohibit direct local competition between steam railroads, and sustain competition between steam and electric roads?

There can be no doubt of the facts that I have already brought out—that electric roads are particularly suited to gather up and concentrate and take away from steam railroads their local business. If the same public policy is pursued by the Middle Western States that is followed in the Eastern States regarding competition between electric roads and steam roads, the latter will continue to lose more and more of their local or first-hand traffic, which will go to the trolley roads; these, with their advantages for profitable extension and development on the low grades and private right of way in the Western States, will eventually build up a system of electric lines parallel to the steam railroad in their best territory and equip themselves to do all kinds of work done by the steam roads and to excel them in handling local business.

The Economical Place of Electric Motive Power.

It is clearly the duty of the steam roads to realize this situation and meet it in some practical and reasonable manner. Whatever else may be necessary in the premises, one thing is clear—that there are many opportunities for the steam railroads profitably to make themselves combined electric and steam lines by utilizing the advantages of electric power. The natural and economic method would be to install on the steam railroads electric service at the most advantageous points, which are also the most vulnerable to trolley competition; to make the new equipment part of a plan of general railroad improvement, and to extend the electrified lines as economy and profit dictate.

If steam railroads were partly electrified, that fact would forestall discriminating legislation between steam and electric railroad companies. The only plausible explanation of the delay by steam railroads in the utilization of electric motive power is that there is much prejudice among steam-railroad officials against the power, and a belief that is unwarranted by demonstrated facts that electric power is not adapted to their needs. It is only because of the very widely different point of view of steam-railroad men and electric-railroad men that their practices and methods are so widely divergent. Eventually the best ideas of the two factions will be united into an efficient concord.

THE BRIDGES OF NEW YORK CITY.

By T. Kennard Thomson.

A STUDENT of engineering, or even an expert bridge engineer, could spend months studying the different kinds of bridges within the city limits of New York. A bare list of them would not be possible in this article, as every style and every form is comprised—from the old King's bridge, built in the seventeenth century, to the great Blackwell's Island cantilever, the biggest cantilever in America—not counting the ill-fated Quebec bridge.

Among these New York bridges we find such an artistic little structure as the jack-knife type over the Gowanus Canal, which opens like the blade of a knife sufficiently for the boats to pass by. It was a bridge of this type, only larger, that recently collapsed in Pelham Bay when nearly completed. Some claimed that the accident was caused by the malicious removing of bolts. Then there are the draw-bridges, in the strict sense of the word, being those bridges which roll or are pulled away from the stream instead of being hoisted or swung around—the latter should be called "swing" bridges and not "draw" bridges, as they often are. The greatest of the swing bridges here is the New York Central four-track bridge over the Harlem River, which cost over $500,000 and is a very rigid structure. The old jack-knife lift bridge which was used by the New York Central while the fine new swing bridge was being built, was taken down and re-erected over the Harlem River at Spuyten Duyvil.

The first bridge to be built on pneumatic caissons* in this part of the world, in 1860, was also over the Harlem River, where the present Third Avenue Bridge now stands. As the French had used pneumatic caissons before us, a Frenchman was engaged to start this work but was not retained long after the start; and for some years past America has led the world in its methods and plant for handling this kind of work.

One of the most recent of the city bridges over the Harlem is the fine swing at Lenox Avenue and 145th Street, the construction of which was delayed for several years from the fact that the Rapid

* Caisson is a French word from *caisse*, a box or chest, also much used for ammunition carriages, etc.

THE FINE OLD SHIP-CANAL BRIDGE ACROSS THE HARLEM RIVER, RECENTLY MOVED DOWN TO FORDHAM HEIGHTS.

Transit Tunnel was designed to run directly under the fenders of the swing span; as soon as the tunnel was completed the fenders were built over it and the erection of the swing span completed. Several pages of this paper could be filled with descriptions of the Harlem River bridges only, the variety of the swing bridges alone being great.

LENOX AVENUE SWING BRIDGE OVER THE HARLEM RIVER.

But to invade the Irishman's territory for a minute—is not the most serviceable bridge over the Harlem River a tunnel under it? All the bridges over the Harlem together are not nearly sufficient to handle the traffic of the present and future, for the low-level bridges obviously require a swing or lift-bridge construction, and the delays of operating the best of these is very vexatious to both land and river traffic. This, of course, does not apply to the high-level bridges like High Bridge, Washington Bridge, and the proposed Memorial Bridge, which form of construction is only adapted to the North River* end of the Harlem.

Probably the prettiest of the swing bridges is the old Ship Canal Bridge—the steel work of which was recently moved from its old piers to new ones at Fordham Heights, and has again been opened to the public traffic for more than a year. An interesting story is told of the contractor who built the original bridge. He constructed the piers himself and bought the steel work from an iron-bridge company, agreeing to pay so much a pound of iron for the erected bridge, and when he received the bills giving the shipping weight of the metal he noticed that the weight of a number of barrels of paint had been included, though not a very large sum. As he was new to this section of the country, he agreed to allow this item provided his consulting engineer said that it was proper, but the engineer ruled the other way.

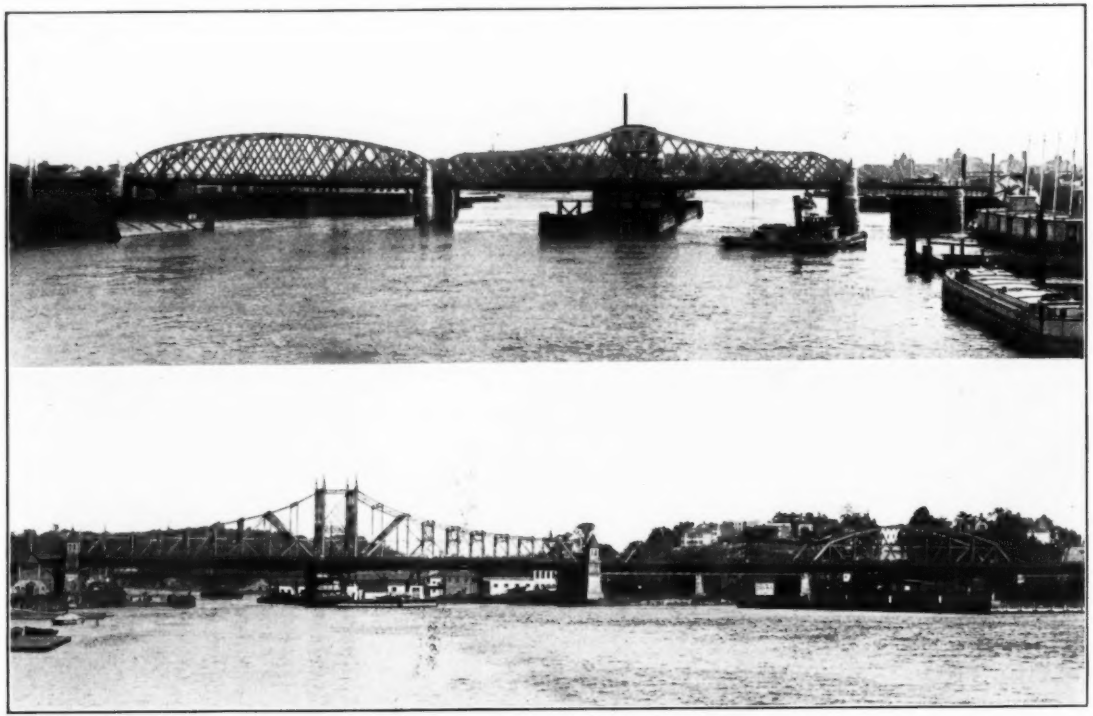
* How many remember that the North River, (the Hudson), was so named to distinguish it from the *South* River (now known as the Delaware)?

BRIDGE OF THE PUTNAM DIVISION, NEW YORK CENTRAL RAILWAY, ACROSS THE HARLEM RIVER.

HARLEM RIVER SWING BRIDGES.
Above, the Rapid Transit bridge, built on the piers of the old ship-canal bridge. Below, Madison Avenue bridge.

The truly grand Harlem River bridges, High and Washington, as well as the East River bridges, are so big and important that they each need a separate description, although some of the latter ought to be physically or structurally connected; some ten years ago when I was the first to publish (in the *Brooklyn Eagle*) a scheme for connecting the Brooklyn and Manhattan bridges at both ends, which would have relieved the Brooklyn Bridge crush, everybody laughed at the idea of the *enormous expense;* but now the question of expense is a secondary consideration.

It might be laid down as a law that there should be *no terminal* for the dumping of human freight on the Island of Manhattan. Imagine, for instance, the subways or elevated railways having ter-



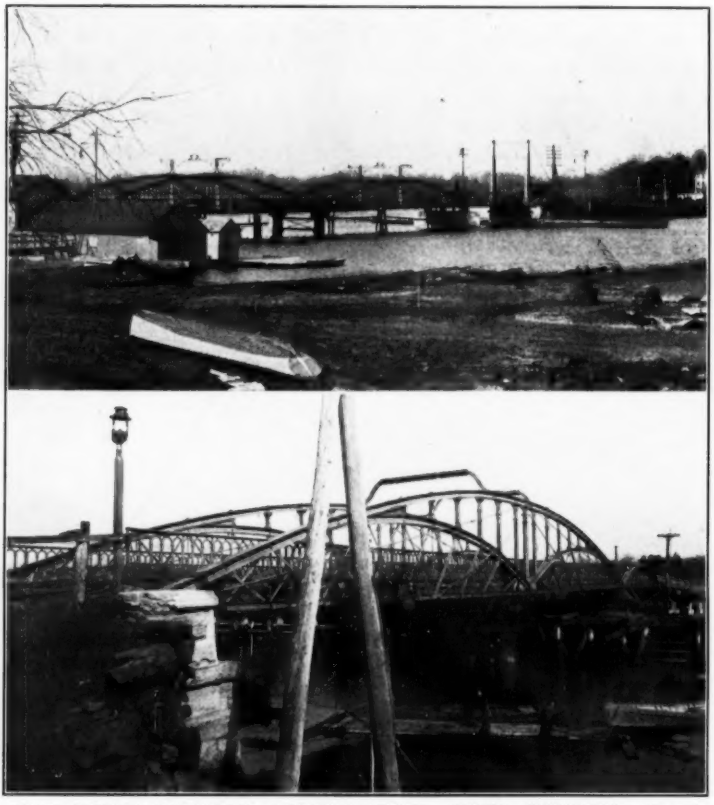
SOME OF THE MANY HARLEM RIVER BRIDGES.
Above, Willis Avenue. Below, Central Bridge.

minals at City Hall and no other stop below, say 42d Street. The Bridge crush "would not be in it." Even the loop that is now being built will not afford nearly as much relief as it would had it followed my original plan of crossing the city to West Street, thus tapping all north and south lines of traffic.

All the bridges and tunnels started up to date will not be sufficient to accommodate the Long Island crowd. A bridge should be started at once close to the old Brooklyn Bridge, with three times its capacity, and then connected at both ends with the Manhattan Bridge, the New York loop passing the North River ferries, etc.

THIRD AVENUE SWING BRIDGE, HARLEM RIVER.

While New York has led in suspension bridges, having three of nearly 1600-feet span each, it is also leading in cantilevers, as the Blackwell's Island bridge is the greatest cantilever in America. It is also now going to make an enormous bound in building the greatest reinforced concrete arch in the world, as the Hudson Memorial Arch Bridge will have a span two and a half times as great as any masonry arch span ever attempted, and we hope that it will not be long before New York makes another tremendous bound when it puts cantilever and suspension bridges across the Hudson River, having clear spans of 3,000 feet or over, as against 1,800 feet at Quebec, the greatest contemplated anywhere else. The feasibility of this has been shown by several carefully worked out plans. But before this is accomplished New York will have again led in another direction and added a 1000-foot steel arch to its record, which will be built at Ward's Island from the design of Gustav Lindenthal, by the Pennsylvania Railroad interests, to bring the New England traffic into Brooklyn.



ABOVE, PELHAM BAY BRIDGE; A UNIQUE DESIGN. BELOW, UNIONPORT; AN INGENIOUS BUT OBSOLETE DESIGN FOR A SWING BRIDGE.

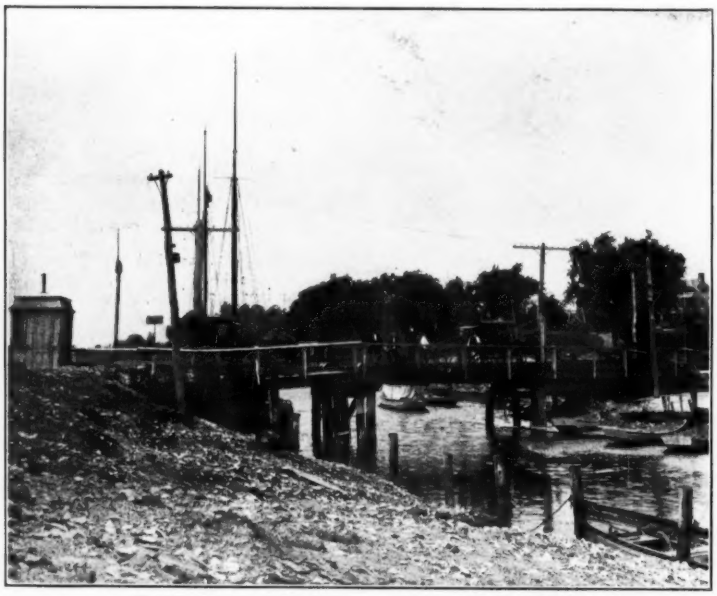
But to come down from the skies for awhile: we have, of course, small reinforced-concrete and wooden bridges galore, but, as a rule, there are not many antiquated bridges left in New York; for when we want a bridge we want it badly, and therefore want a good, not a bad one, which means continual rebuilding; for most designs of over 25 or 30 years are now obsolete as far as new work is concerned. Even the grand old Brooklyn Bridge, a masterpiece in its prime, will never be duplicated. But there is one old bridge which no New Yorker wants to see replaced, nor is there any reason why it should be, for it was very well constructed and is still an artistic engineering triumph. I refer to High Bridge—of which more anon.

BRIDGES OF THE BRONX.
Above, Hutchinson River; a modest swing. Below, Westchester; a novel plate-girder swing.

There is one type of bridge we have not here, and it is to be hoped we will not have it, although we nearly had one over Newtown Creek; and there is one over the Thames at London, as well as a few in the United States—and that is, a Tower Bridge, where a tower is built on each side of the stream and the bridge between the towers is suspended in such a way that it can be raised (both ends remaining horizontal) so that ships can pass under. Some have stairs and others elevators, so that people who do not wish to wait for the bridge to be lowered can go up one tower, walk across, and go down the other tower. As a rule, a tunnel would be better than such a bridge.

A well designed bridge has three great dangers to contend with. The first is rust, the prevention of which requires eternal vigilance

and plenty of good paint. The second and less well-known is electrolysis, and unless much greater care is taken against grounding the current a great catastrophe will some day occur. This statement is the result of observations and not a theoretical conclusion, for steel anchor bolts in New York have been completely eaten up by very small escaping currents. The third danger is that of overloading or forcing the bridge to carry much greater loads than it was ever designed for. This seems a childish warning in some respects, for if it is well-known what load the bridge can safely carry one might ask why greater loads are allowed. That reminds me of an experience when, as a young man, I was designing a derrick for a contractor and was trying to find out what would be the heaviest load that he would probably lift with the derrick; an old engineer who was listening to the discussion turned to me and said, "You can bank on the fact that the superintendent for the contractors will try to lift the heaviest load that he can reach with the derrick, no matter what capacity it is designed for." And so with bridges; they try to let everything that wants to, pass over; so the only safe way is to follow, to a *certain extent,* the advice Smeaton, that famous old English engineer, once gave to a young engineer: "When you build a bridge,



FRESH KILLS, RICHMOND, A SMALL DRAW BRIDGE.

HIGH BRIDGE, CARRYING THE OLD CROTON AQUEDUCT ACROSS THE HARLEM RIVER.

make it strong, sir, make it strong, and when you have got it strong, make it damn strong." The endeavor to make bridges just strong enough has resulted, owing to the constant increase in rolling stock, etc., in causing iron bridges to be rebuilt, sometimes several times, in the last fifty years, when they were supposed to last forever.

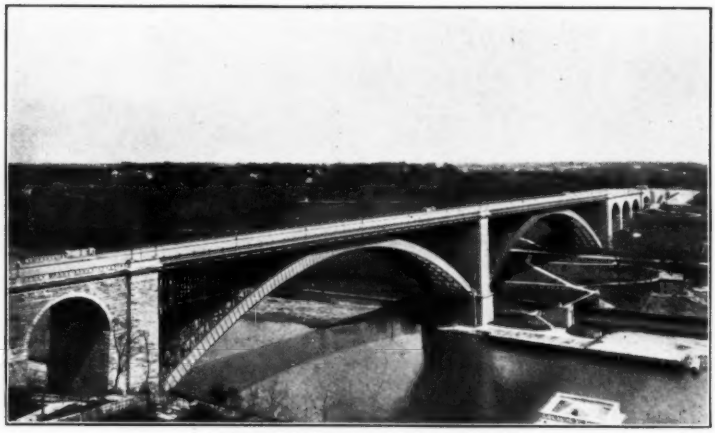
The present elevated road was built too light, and we often hear that it should be removed and replaced by tunnels; but I for one sincerely hope that, when the time comes, the elevated-railroad structures will be renewed with better and finer ones; for, at the very best, travel in tunnels can never be as healthy as travel in sunlight. Who does not know that an unwhitewashed cellar is absolutely dangerous to the health? And yet our subways are nothing but a string of cellars which badly need whitewashing. Has not this something to do with the great amount of "grippe" and similar diseases, with which we have been afflicted? At present we are "tunnel mad," but soon the fever will turn to bridges again to reduce lung fever. This is not inconsistent with the statement that tunnels under the Harlem River are to be preferred to low-level bridges.

High Bridge.

This is the oldest of the big bridges of New York, completed in 1849, remaining ever since as a work of art and an example of the best engineering construction.

The primary purpose of this bridge was different from any of the others, as it was designed to carry the Croton water across the

Harlem River in a 7½-foot pipe, following the old Roman practice of carrying their aqueducts over bridges instead of under the river through tunnels. When High Bridge was started, it was not considered safe to risk a tunnel for the water supply; hence this massive bridge which, however, was only 24 feet wide at the top, to carry a single water pipe. It speaks well for the engineers and contractors that it was made, and has remained ever since, water-tight—quite a difficult feat when one considers the effect of contraction and expansion of material and the fact that good Portland cement was not obtainable in those days.

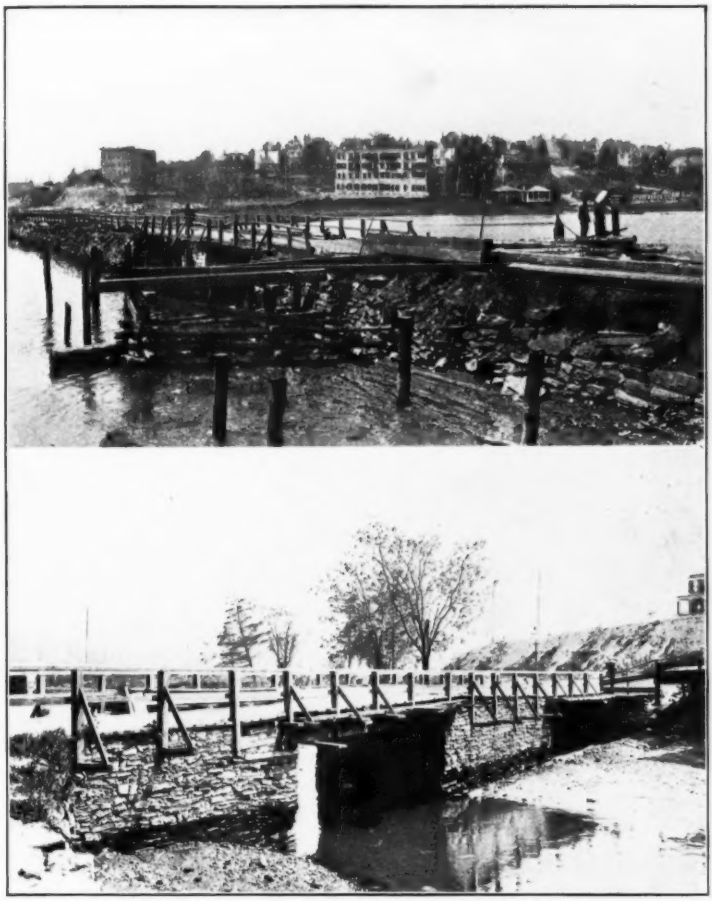


WASHINGTON BRIDGE, HARLEM RIVER.

The total length is 1,450 feet, made up of clear spans of 80 feet, the distance center to center of piers being 94 feet, and the clear height above water 100 feet. This bridge was completed three years before our great American Society of Civil Engineers was founded, in 1852, the engineers of the bridge being prominent in the forming of the Society.

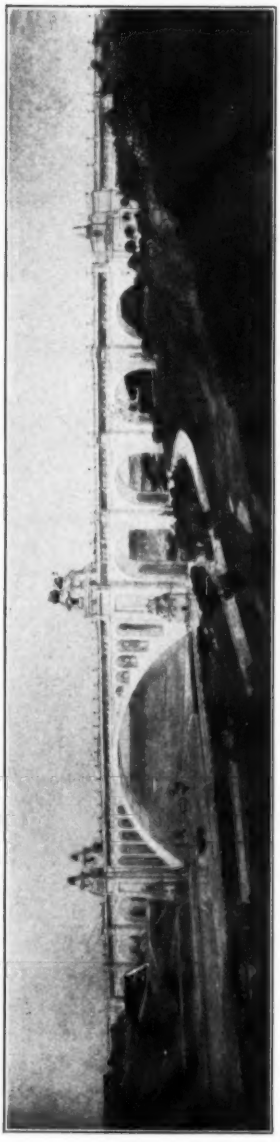
Washington Bridge.

Fortunately the next bridge after High Bridge to cross the Harlem River, at 181st Street, is also a work of art as well as engineering, engineers as a rule being too prone to consider cost before beauty. Washington Bridge is about 2,400 feet long and 80 feet wide, the two main arches are 508-feet span each—one over the Harlem River and the other over the tracks of the New York Central Railroad. This, one of the finest bridges in America, was obtained by offering prizes for the best set of plans, and though the committee



TWO HISTORIC BRIDGES OF UPPER NEW YORK.
Above, Farmer's Bridge, in the Bronx, of the 18th century. Below, King's Bridge, of the 17th century and of today.

awarded the first prize to Mr. C. C. Schneider, as they considered his design to be the finest, they, nevertheless, decided to build the bridge according to the contractor's plans on account of the expense—a unique proceeding; but by modifying the plans slightly, using some of Mr. Schneider's and others' ideas, a most creditable bridge resulted at a cost of $2,850,000, of which about $900,000 was spent on the steel work. The construction of this bridge was commenced in 1886 and completed two years later.



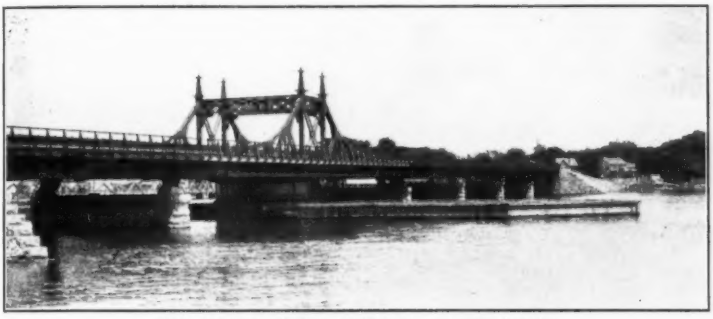
THE PROPOSED HENDRIK HUDSON MEMORIAL BRIDGE, OF 700-FEET SPAN.

Old King's Bridge.

As this neighborhood is one of the most interesting historically in New York, so much so that an antiquarian could fill a book on the rich find of relics which have been made, it is fitting that we should have at least one really old bridge here, and the King's Bridge over Spuyten Duyvil Creek is undoubtedly the oldest bridge in New York City, having been built by Frederick Phillipse, Lord of the Manor of Phillipsburg, who maintained it as a toll bridge under Royal charter. The superstructure, however, has recently been rebuilt. This was on the highway from New York to Albany and Boston. Farmers' Bridge, near by, was built by Jacob Dykeman and Johannes Vermilyea in opposition to the toll, King's Bridge. Farmers' Bridge is often mentioned in the historical records of the eighteenth century, and King's Bridge in that of the seventeenth century.

Ship-Canal Bridge.

We have already referred to the construction of the Ship-Canal Bridge which was recently moved to Fordham Heights at a cost of $80,000, the total cost of the new foundations and approaches bringing the cost up to about $1,000,000. This bridge was moved to allow the Rapid Transit Commissioners to build a double-deck structure at the old site. The new draw span was erected on piles between the two sites, after which barges were placed



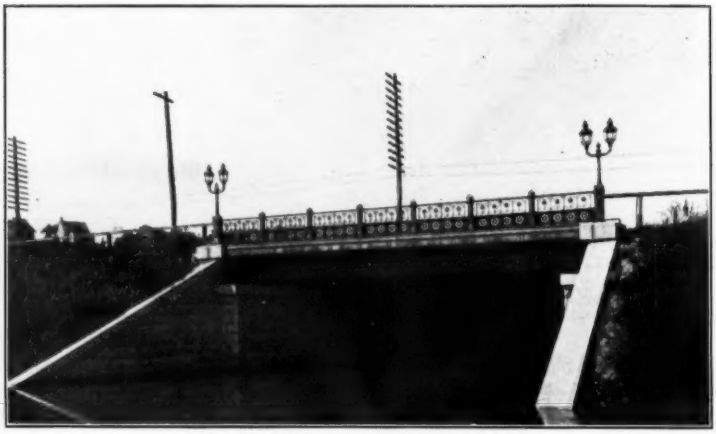
CITY ISLAND BRIDGE, BOROUGH OF THE BRONX.

under it and blocking arranged so that, as the tide rose, it lifted the bridge off its supports to permit it to be towed up stream and placed on the old piers, the old superstructure, by the same method, being removed to its new site at Fordham, causing the least possible delay to traffic. This necessarily required very careful and accurate calculations, the correctness of which was proved by the moving being completed without a hitch.

Hudson Memorial Bridge.

Some years ago a body of citizens decided to erect some structure to commemorate the sailing of Hendrik Hudson up the North River in 1609, and they determined to erect a bridge to carry the extension of Riverside Drive north across the Spuyten Duyvil Creek near its connection with the Hudson River. One of the first plans submitted was for a steel-arch bridge having a main span of 825 feet, but this was rejected, as it was desired to have a memorial bridge of indestructible material—to be a monument forever. So it was finally decided to build a reinforced-concrete bridge having a main span of 700 feet, according to the beautiful design shown here. And it certainly will be monumental, as can be realized when we know that the longest reinforced concrete arch completed is only of 230 feet span and is in Germany, while the longest yet attempted in America is only 233 feet as against the 700 feet for the Hudson Memorial.

While the design is certainly bold, there is no cheese-paring economy about it, the concrete at the crown being 15 feet thick and at the skew-backs 28 feet thick, the whole bridge having a width of 70 feet. The arch will be heavily reinforced with steel angles, etc., forming twelve ribs or trusses. The weight of these steel ribs alone will be about 8,500 tons. A series of columns on top of the arch



SPUYTEN DUYVIL. A PLATE-GIRDER SPAN.

will carry a double-deck floor. Under the crown of the arch will be a clear space of 177 feet above the water. The East River bridges require a clear height of 135 feet.

The bridge will be about 3,000 feet long, and it is estimated that it will cost $4,000,000. The completion of such a bridge will not only be a monument to Hendrik Hudson, but also to the designers who dared to cast precedent to the winds.

While the general public will be chiefly interested in the cost and the beauty of the conception, the first question an engineer will ask is, how will it be erected, for they realize what an enormous weight, 100,000 tons, must be carried by the false works, or "centers" as they are called. This amounts to 2 tons, or 4,000 pounds for every square foot of floor, or probably 30 times the load that will ever pass over the completed structure.

If the false works were carried on piles, the piles would have to be placed every 3 feet apart in both directions, completely blocking the channel, which would not be permitted. So three pneumatic caissons will probably be sunk to rock to carry steel towers and trusses forming the centers, all of which will be removed on the completion of the permanent structure, the concrete being allowed at least six months to set before the centers are struck.

Europe often leads the United States in the artistic beauty of its bridges, but it has nothing on the scale of this Memorial Bridge, a grand bridge on a grand site.

CONSTRUCTION IN EARTHQUAKE COUNTRIES.

By William Herbert Hobbs.

Professor Hobbs presents, with authority, very clear conclusions upon a subject which has lately attracted earnest attention internationally, and which is of large economic and engineering importance. San Francisco, Kingston, Messina, and a number of remoter disasters have awakened inquiry into measures for protection against similar destruction in the future. The distrust of seismic conditions on the Isthmus makes it important to safeguard the great works of construction along the Panama Canal. On all these points, Professor Hobbs's article will be found most instructive and helpful.—THE EDITORS.

DESTRUCTIONAL SHOCKS. Earthquake shocks have been classified into successional and frictional vibrations. Those designated as frictional, which within the much disturbed region are made manifest as subterranean rumblings, may here be omitted from consideration, since their amplitude is too small to affect the stability of buildings or other artificial structures. To damage well built structures such as man is accustomed to raise, the movements of the ground must be both relatively large and rapid. "World shaking" movements in New Zealand may have, even in England upon the antipodal side of the planet, an amplitude of motion which is measured in inches. Since, however, their period of vibration reaches into the tens of seconds, and their wave length into the tens of miles, these displacements also are without permanent effect upon artificial structures. It is, for these reasons, the successional shocks only and the area of sensible disturbance alone, with which we are here concerned.

It is customary to gauge destructive shocks of earthquake in terms of (1) their amplitude, (2) their velocity measured in inches or centimeters per second, and (3) their acceleration, or augmentation of velocity, measured in inches or centimeters per second per second.

THE HAZARD OF THE LOCALITY. Inasmuch as the very nature of earth displacements implies a localization along definite lines of earth fracture which are repeatedly the seats of movement at the time of earthquakes, it is of prime importance to make proper choice of location for the community as well as for the structure itself. The larger problem of location for a city or town may be determined, to a large extent, by considerations which are primarily commercial, though in the case of residential places, sanitary and aesthetic as well. The few harbors along the Pacific coast of the United States make it certain

that great cities will always be located on or near the sites of San Francisco and Seattle, however great the danger from earthquakes may be. It is unfortunate that the criteria which must in large measure fix the location of great cities, are such that these are likely to be places of relatively high seismicity. A deep or a land-locked port, a gate city at the front of a mountain barrier, a large water power, or the head of navigation upon a river—all these considerations raise the probable seismicity of the locality.

If we consider the older cities whose histories go back to the time when capacity for defense rather than commercial advantage was the determining factor in their location, we find that it is the vicinity of a steep slope above which a castle could be perched, that has made the locality a seismically dangerous one. There are some lines in the surface of the ground which, because above main faults, are so dangerous that structures should not be reared upon them; but except along these narrow zones it is safe to say that essentially earthquake-proof construction is possible.

THE STUDY OF THE SITE. There is small ground for hope that except where communities have already been largely destroyed by an earthquake, they will be constructed with much reference to a safeguarding of the future. History reveals only too plainly a pertinacity which amounts almost to stubbornness in carrying out traditional rather than scientific methods of construction, even after repeated disasters. It is fortunate that in those communities where there is hope of introducing reforms, there is a possibility of determining the places of greatest danger. In all cases where a community has been visited by earthquake a map should be prepared to indicate clearly where shocks were heaviest—where structures were most damaged, regard being had to their relative stability and to their capacity to withstand various types of differential stresses.

This map having been prepared, it will perhaps first of all be noted that areas singled out for special destruction correspond to areas above loose foundations, such as valley bottoms, whereas structures situated on rock have suffered relatively little. This is a fact of rather general observation, to which there are, however, many noteworthy exceptions. Other things being equal, the unconsolidated formations afford much more dangerous building sites. If well drained, and hence comparatively dry, such deposits are less dangerous than others which are habitually wet; and hence a marshy tract or a former stream bed is an especially undesirable site for a building. So-called "made" ground with its crockery, tin-can, and rubbish ingredients, is especially subject to collapse under earth shocks, and

this offers an additional source of danger. The boundaries of all "filled" areas within a community should therefore be determined, so that structures raised above them may be constructed with special precautions. Insurance companies may wisely take cognizance of the nature of foundations in insuring against damage from earthquakes.

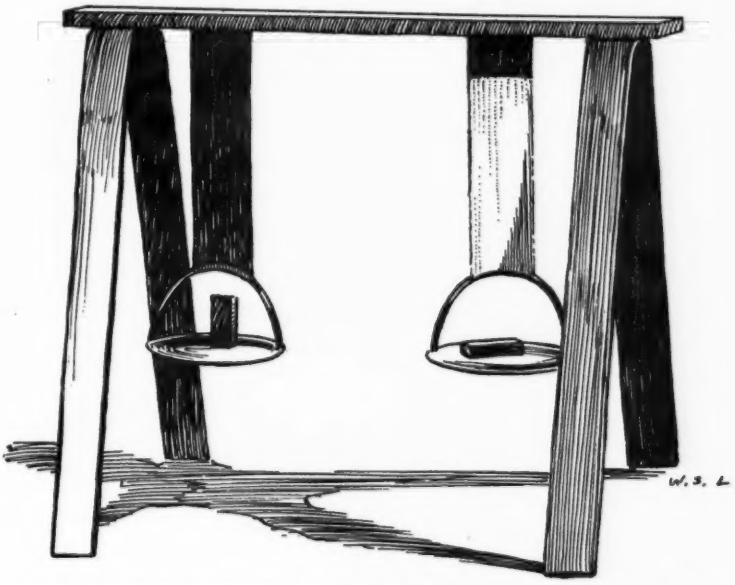


FIG. 1. DEVICE TO ILLUSTRATE THE PROPERTIES OF "SOLID" AND "LOOSE" GROUND WHEN DISTURBED BY AN EARTHQUAKE.

REASON FOR LIGHTER SHOCKS ON ROCK FOUNDATIONS. The simple device represented in Figure 1 may serve to illustrate the widely different properties of "solid rock," and of unconsolidated deposits, which make the first a relatively safe foundation in earthquake districts. Two metal stirrups of the same dimensions are attached to a metal support, the one by a steel plate, and the other by a piece of so-called "elastic" braid of the same dimensions. Steel has a high rigidity and elasticity, but permits little amplitude of displacement even when subjected to large stresses. In these respects it resembles rock. The "elastic" braid, notwithstanding its name, is much less elastic and of very little stiffness or rigidity, but it permits of extreme distortions of its form under the action of light shocks.

These properties belong also to unconsolidated deposits, such as valley fillings and "made" ground.

If, now, light shocks of the same strength be communicated to each stirrup, the one attached to the steel band is but slightly affected, whereas the one upon the braid support is thrown into a violent agitation, and any unstable body resting upon it will be upset. It should not be forgotten that the shocks would be transmitted to a much greater distance in the steel than they would in the braid, since the very lack of stiffness and elasticity tend to dissipate the energy of the movement. A sharp blow administered to the metal support is transmitted with little loss of energy to the stirrup connected by the steel, though it affects but slightly the other. It is not unlikely that there is a definite thickness for loose material beyond which the dissipation of the energy from this source may overbalance the augmentation of shock amplitude due to the lack of coherence of the material. This subject needs investigation.

The tendency of unconsolidated deposits to undergo internal adjustments so as to become locally either more or less compact than they were before the arrival of the shocks, must bring about modifications in the direction and character of the shocks themselves. Considerable displacements within the underlying rock basement will hardly appear as such at the surface of the ground, provided the layer of loose material is sufficiently deep. Horizontal differential movements such as in solid rock would appear as offsets at the surface and cause large overturning movements, would by passing upward through a thick cover of loose deposits be inevitably greatly modified in character, and it is probable that the strength of the shocks might be either less or more than they are in the solid rock below.

Presumable Lines of Fault. The damage map of a community which represents either in different colors or shades the varying degrees of distruction in the different sections, as these have been revealed by historic earthquakes, should be carefully scrutinized for any indication of the presence of lanes of distruction or of special focal points. These lanes or foci may represent the location respectively of faults or of their intersections. The probability that the lane of distruction is on this account a zone of special danger, will be so much the larger if it is found to correspond in direction either with known faults in the vicinity or with prominent joint fissures within the basement rock of the neighborhood. All lines or spots of special danger thus indicated with probability, should be utilized for parks or boulevards, and so far as possible avoided in locating important structures.

THE EARTHQUAKE-PROOF HOUSE. A building in the throes of an earthquake tends to vibrate like an inverted pendulum, or more frequently like a series of them, since it is usually constructed of different materials each having its own natural period of vibration. Not only do the different materials correspond to different vibration periods, but if there are wings or extensions to the main portion of the building, these parts, in so far as they vibrate as units, will further have different periods from the main portion. It is this difference of vibration period which gives rise to differential internal or "racking" stresses tending to destroy the integrity of the structure. If all parts can be so firmly joined together that the building moves essentially as a unit, it may be said to be "earthquake-proof." The building might still be overturned bodily, but except over or very near a main fault line, experience indicates that this is not likely to occur. Again, it might be sunk into loose deposits, but this can probably be largely prevented by providing suitable artificial foundations.

BUILDING METHODS, PROFESSOR MILNE'S COMPILATION. Many years ago Professor Milne undertook an extended compilation of the building methods adopted in various earthquake countries. Copies of the building regulations which were at the time in force were diligently assembled and translated, and what was of value was extracted and utilized in the preparation of a set of general rules, which for the most part need but slight alteration today so far as the building types to which they refer are concerned. These studies were published as Vol. 14 of the Transactions of the Seismological Society of Japan.

JAPANESE EXPERIMENTS ON STABILITY OF STRUCTURES. When in 1892 the Earthquake Investigation Committee of Japan was organized, one of its subjects was "to investigate what can be done to reduce disastrous effects of earthquake shocks to a minimum by the choice of proper structures, materials, position, etc." The frequent light shocks and the occasional disastrous ones to which Japan is subject, make of it a natural earthquake laboratory, and elaborate tests with seismographs were early undertaken by the Committee to determine the relative intensity of shocks in different types of buildings as well as in different parts of the same building. The destruction which resulted from the Mino-Owari quake of 1891 was carefully studied, and a series of laboratory experiments was carried out by use of a specially constructed "shaking table," in order to learn especially the relative stability of columns of various dimensions and materials when subjected to harmonic vibrations of known amplitudes and periods. Unfortunately most of the literature of these studies is in the Japanese language, but in 1897 a series of publications was

begun in foreign languages, mainly English, and in these publications some important papers became generally accessible.

In 1905 the whole subject of proper earthquake construction was thoroughly gone into by the Count de Montessus de Ballore (*L'art de Construire dans les Pays à Tremblements de Terre,* Leipzig, 1905), and in 1907 the subject was again discussed in a more general way by the same distinguished authority in his *La Science Séismologique.*

THE NEW CONSTRUCTION IN CALABRIA. Previous to the earthquake of 1905, the normal type of peasant dwellings throughout Calabria had walls built up of rounded boulders loosely cemented by a weak lime mortar of home manufacture, and surmounted by a roof of heavy tiles loosely supported upon poles. These human deadfalls have sometimes after an earthquake been reared in the same fashion above their own ruins. The distruction wrought by the shocks of 1905 made it necessary to rebuild largely many entire villages of the province, such, for example, as Martirano, Aiello, Iacurso, San Leo, Favelloni, and Mellicucca. This work was taken up by the Milan Committee *(Comitato Lombardo)* upon plans approved by competent seismologists, and now for the first time in history the lives of the Calabrian peasants in certain villages are insured against the great scourge of the province. Mario Baratta, the well known authority upon Italian earthquakes, has described the various types of structure in some detail in a Bulletin of the Italian Seismological Society.

As a consequence of the terrible disaster to Sicily and Calabria last December the Italian Government has acted vigorously, and on April 18, 1909, by royal decree No. 193, a set of regulations was promulgated which must be adhered to "in repairs, reconstructions, and new constructions of the edifices public and private in the villages damaged by the earthquake of December 28, 1908, or by other earlier ones." These regulations have been published by the Italian Ministry of Public Works on April 23, 1909 (See bibliography at end of this paper).

THE LESSONS OF THE CALIFORNIA EARTHQUAKE. The California earthquake of April 18, 1906, by applying the natural earthquake test to modern building types, has for the first time shown the earthquake-resisting qualities of a large variety of building materials and structural types. The published material relating to the subject, so far as it is of special importance to architects, builders, and engineers, is chiefly contained in two sources, one a bulletin of the United States Geological Survey (No. 324, Washington, 1907), and the other the

report of a number of local committees in San Francisco of the American Society of Civil Engineers (Trans. Am. Soc. Civ. Eng., Vol. 59, 1907, pp. 208-329). The best general summary of the results is perhaps contained in a paper written by Professor Charles Derleth, Jr., and published in "The California Earthquake of 1906," a popular work edited by President David Starr Jordan and published by Robertson of San Francisco in 1907.

FIG. 2. HAVOC WROUGHT IN BUILDINGS OF MASONRY AND TIMBER IN THE CITY OF MESSINA BY THE SHOCKS OF DECEMBER 28, 1908. THE STONES ARE IRREGULAR AND CEMENTED BY WEAK MORTAR.

FOUNDATIONS OF BUILDINGS. It has already been shown that loose or unconsolidated materials make a particularly dangerous foundation for buildings in seismic districts, and this not alone because they are in danger of sudden settling, but because earthquake vibrations are in them transformed into displacements of relatively large amplitude. These large-amplitude waves, however, are apparently restricted to the surface layers of the material, probably because superincumbent rock material imposes a restraint upon the motions of rock particles in proportion to its weight or depth. Experiments carried out by Professor Milne during a severe earth-

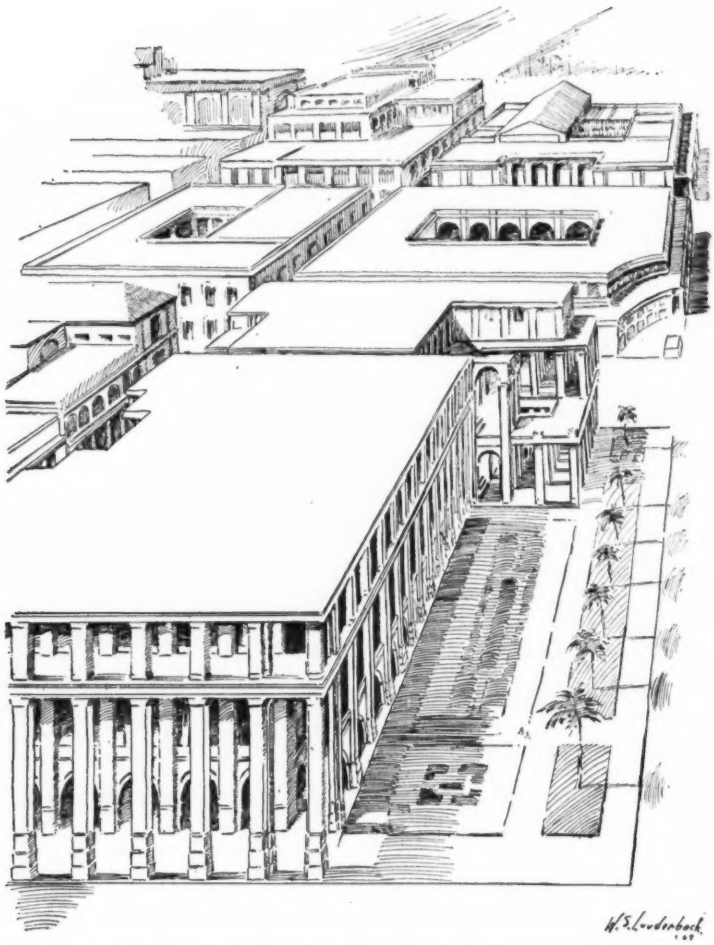


FIG. 3. THE NEW GOVERNMENT BUILDINGS NOW UNDER CONSTRUCTION AT KINGSTON, JAMAICA. ALL ARE TO BE CONSTRUCTED FROM REINFORCED CONCRETE.

quake in the city of Tokyo in 1885 showed that the vibrations in hard ground in the bottom of a pit ten feet in depth, were but a fraction of what they were at the surface of the ground. The amplitude of motion at the bottom of the pit was only one thirty-fourth of what

it was at the surface ten feet above, while the maximum velocity and the maximum acceleration were respectively one fifty-second and one eighty-second of their surface values. Later studies by Professors Sekiya and Omori, on the other hand, showed that for *small* earthquakes there is practically no difference between the motions at the bottom of a pit and those upon the surface of the ground. It is a fact long known that severe earthquakes may cause much damage at the surface and not be noticed by miners in the galleries below.

The examination made of buildings in San Francisco after the earthquake of 1906, showed that where deep and suitable foundations had been prepared, the destruction of well-made buildings was relatively small. Even the Ferry Building, resting as it did upon the outer edge of the made-ground of the city, stood the shock splendidly because of excellent pile foundations. The Call Building of fifteen stories and cupola, built upon sand, was but little damaged, and this rested upon a foundation of concrete with a skeleton of steel grillage. Professor Derleth has recommended that on soft ground, buildings too light to require pile foundations might well have cellar slabs of reinforced concrete, which would act as units with the wall footings and give distributing power as well as prevent unequal settlement.

The vibrations of large amplitude being in loose materials a largely superficial phenomenon, the building is in a measure protected if it rises freely from the deep foundations and is separated by a trench from the surface layers of the ground. Where no particular difficulties lie in the way of providing such a trench, the method may doubtless be employed to great advantage.

Materials of Construction. A number of years ago the Count de Montessus called attention to the adaptability of reinforced concrete to the construction of earthquake-proof structures. The recent Jamaican and California earthquakes seem to have indicated the superiority of this material over most others which are in use. The importance of this fact is not likely to be over-estimated in view of the cheapness of the materials from which concrete may be manufactured, and the occurrence of them in practically all countries. A further advantage not always recognized exists in the fire-resisting qualities of reinforced concrete; for to protect buildings effectively from earthquakes it is necessary to protect them from the fires which so generally follow destructive shocks. The coefficients of expansion by heat for steel and cement are essentially the same, so that tested in a fire the two substances expand together. For this reason the cement cover is not cracked, and as the wrapping is a poor heat conductor, the steel skeleton is neither softened nor buckled.

For high office buildings, the future building material in earthquake districts will probably be steel-frame cage construction with reinforced-concrete curtain walls; all steel members encased in concrete; the floors of reinforced-concrete slabs supported on structural haunches. The shallower types of foundations should consist of concrete footings reinforced with steel grillages. The deeper types should have pile foundations with concrete and steel grillages at the tops of pile clusters, or in especially treacherous ground special foundations such as the pneumatic caisson (Derleth).

Brick and masonry, as has often been pointed out, are eminently unsuited to construction in earthquake districts (see Figure 2). Yet, as it is hardly to be expected that their use in such localities will be at once discontinued, it is important to urge that brick and masonry buildings be constructed with a view to resisting the less violent shocks. Walls of masonry should in all cases be bonded, and cemented with a mortar containing a large proportion of cement. Experiments recently carried out in Japan indicate that one part of cement and one to three parts of sand is as tenacious as pure cement. Derleth recommends the use of cement with just enough lime to make it workable—one part of cement to four or five of lime mortar. Mortar should never be applied to dry brick.

In rural districts the use of wood, bamboo, or thatch are all permissible in the construction of small buildings; but both to afford a refuge from falling chimneys and to secure protection from general fires, the buildings should, so far as possible, be separated by distances at least double their height.

Two Contrasted Types of Earthquake-Proof Structures. Nearly a score of years ago Professor Milne used the wicker basket and the steel box to illustrate two strongly contrasted types of earthquake-proof structures. The box of steel possesses the necessary strength to resist sudden shocks, but has the undesirable property of very considerable weight. The basket, with very moderate strength only, is light and hence has relatively small inertia either of rest or motion. It has in addition the structural peculiarity that when it yields to shock there are aroused within itself resistant forces, before passive, which up to a certain limit are augmented in amount in proportion as the demand is made upon them. The force of the shock is thus met and balanced, and the elasticity of the material largely restores the structure to its former condition. In this respect there is an analogy with the recoil mechanism of a great gun, or, to come nearer to seismology, with the damping device of a seismograph.

The American practice of "baggage-smashing," which has grown

up as a natural consequence of the liberal allowance of passenger's baggage on American railways, has evolved practical illustrations of structures designed to resist sudden shocks. On the one hand we have the wicker and leather types of trunk possessing the properties of lightness and toughness, and, upon the other, the heavy "Saratoga" and "bureau" trunks, which, strongly bound with iron, supply strength in proportion to their heavy weights.

THE MOMENT OF INERTIA. It should be borne in mind that save only where there is a large differential movement (or shear) of the ground underneath a structure, as over a main fault, the forces which a structure must be designed to meet are those only which are a direct consequence of its own inertia. This inertia depends upon weight and upon the distance above the ground at which it is concentrated.

The motion which is most effective in wrecking a building is one directed horizontally, and whatever the direction of the shocks, it is the horizontal component of the motion with which we have especially to reckon. When the ground is moved sharply to one side beneath the structure, every portion of the building by virtue of its inertia of rest, tends to move in the opposite direction. Held to the ground by the stiffness of the structure and its weight, every particle in it must be conceived as at the end of an arm which is pivoted either at or below the surface of the ground. Each particle, therefore, may be conceived to be an inverted pendulum, and the structure as a whole to be made up of an almost infinite number of such pendulums. The moment of inertia of the structure as a whole, provided its stiffness and rigidity permit it to move as a unit, can be obtained by a process of summation of the moments of inertia of its component particles.

ELASTIC *versus* MONOLITHIC STRUCTURES. It has been urged, perhaps too strongly in some quarters, that buildings be permitted to undergo considerable deformation when they yield in response to vibrational shock. For light bamboo or frame structures such considerable deformation is no doubt desirable, but well designed and honest structures of the better class succumb to earthquake shocks through a failure of their joints by the racking motion to which they are subjected. If constructed with a steel frame, the bolts or rivets are sheared off, especially at the points of connection of tie members. The nearer the monolithic condition is attained, in which amplitude of internal strains is reduced to a minimum, the less will this racking become.

A comparison of the behavior of steel frames in a casing of concrete with others not thus protected, when tested by the California earthquake, should afford a decisive answer to the question, since the

concrete casing stiffens the frame and largely reduces its elastic property. As reported by Osborn:

> In almost every instance where the skeleton steel structure stands practically uninjured, it is where the steel was covered with a coating or jacket of concrete, and where the building was provided with reinforced monolithic concrete floors and foundations. At the same time there were buildings that stood beside those now standing that were also constructed on steel-skeleton methods, but provided with floors and coverings of clay tile and brick; materials which are fire-proof in so far as burning is concerned, and yet the steel skeleton is entirely wrecked.

Tall Buildings and Their Stability. Modern office buildings of the "sky-scraper" type were first tested by earthquake at San Francisco April 18, 1906. Their splendid behavior, when well designed and constructed, has been a surprise to many who have perhaps assumed that they would be unstable in direct proportion as they were lofty. If the law of stability which holds for ordinary low buildings were to apply without change to those of great height, they would be exceedingly unstable. The acceleration of motion necessary to fracture a building regarded as though it were a square monolith or column, is directly proportional to its width in the direction of the motion, and inversely proportional to the square of its height. The acceleration necessary to overturn the building also depends upon its thickness and height and is expressed by West's formula:

$$a = \frac{gx}{y}$$

where g is the acceleration of gravity (32.08), x the thickness of the building in the direction of the horizontal component of the motion, and y the height of its center of gravity above the ground. It is thus seen that a tall building should be incapable of withstanding strong earth movements.

The laws of the fracturing and overturning of columns, as above expressed, apply strictly to those buildings only whose dimensions are not so very much greater than the range of motion of the ground. It was found in the case of tall buildings in San Francisco that their tops tended to remain at rest, though the base oscillated with the ground during the earthquake. In the top stories loose objects were less disturbed and thrown about than they were in those near the basement. This is probably because the building constituted an inverted pendulum of such long arm that its period was many times slower than that of the earth particles at the base. The earth waves in traveling up the building would, on this account, be transformed into others of longer wave length. The later waves would thus

come to overtake the earlier ones, and by combining with them would destroy a large part of their mutual energy. The wrecking strains were found to be the greatest in the first story above the ground. Some preparation for this discovery should have been afforded by the knowledge that Japanese temples in some instances five stories in height have so long withstood the Japanese earthquakes.

A practical illustration of the transformation of waves is furnished by a ship riding at anchor in the sea which follows a storm. Not acted upon to any large extent by the wind, the water waves which reach the vessel are transformed into others of longer wave length, so that the ship in an attempt to vibrate with the period which is natural to it, sends out waves of a period intermediate between its own and that of the oncoming waves. There is need of careful experimentation to determine the exact manner of transformation of earth waves in structures which simulate high buildings.

RECTANGULAR *versus* TRIANGULAR MEMBERS IN FRAMES. It has been urged by some that to secure stability in a structure it is necessary to give it the property of yielding under shock. To quote Professor Derleth:

> Earthquake forces, relatively speaking, are unlimited in amount where the strength of human structures is under consideration. . . . . The stiffer a structure the greater will be the induced stress produced by earthquake vibrations. The more a structure is capable of yielding, like a willow tree to the storm, the less will be the tendency to earthquake rupture or collapse.

For this reason he has advocated the use of rectangular framing with stiff joints in the place of triangular framing such as is in use for wind bracing. A framework composed of rectangular members may undergo a change of form without change in the length of its members, whereas a frame with triangular bracing by a similar distortion would loose its integrity because triangles cannot change the size of their angles without a corresponding change in the lengths of their sides. If this view is to be accepted it is necessary to lay especial emphasis upon the necessity of stiffening the joints, since otherwise the structure would easily collapse. To quote Derleth again:

> In steel buildings, rectangular framing is best produced by substantial continuity in the main columns and by bracing these columns with deep horizontal spandrel and floor girders; or by more shallow spandrel and floor girders strengthened by heavy knee braces.

AN EARTHQUAKE'S MANNER OF WRECKING A BUILDING. Buildings which succumb to earthquakes may be wrecked by any one of a number of causes. Where their frames are exceptionally weak the

building may collapse through a well distributed horizontal shear, in every way analogous to the displacements of a pack of cards disturbed by a jar of the table. Instead of being well distributed, a rupture through a shear may be localized at the junction of the two stories of the building, either because the studding is not continuous past the joint, or because it has there been weakened from mortising (see Figure 4). When roof beams have not been properly tied at the bottom, the vertical component of the shock results in a sudden settling of the roof causing it to spread at the base and "kick" over the walls.

FIG. 4. BUILDING WRECKED AT SAN MATEO, CALIFORNIA, DURING EARTHQUAKE OF 1906 (AFTER J. C. BRANNER).

When floors are not properly anchored to the walls the horizontal component of the shock causes these heavy masses to be thrown against the walls like battering rams so that the building is wrecked in parts (see Figures 5 and 6). In a similar way heavy roofs when not properly anchored to the walls are slid over them, and being left without support, collapse. (See Figure 4.)

If a building is so thoroughly braced as to act essentially as a unit, the force of the shock may project it from its foundations. In the case of light peasant's houses in Japan, it has been a common practice to reduce the strains upon the building by facilitating so far as possible such a movement, which is accomplished by supporting the structure upon rounded boulders.

Buildings are often partially wrecked through the projection of parts, such as chimneys, staircases, and cornices, these being relatively heavy and vibrating with an individual period.

GENERAL BUILDING RULES. To be earthquake-proof a building should have a strong frame, well braced and tied together by a sufficient number of partitions. It should further be as simple as possible in plan, since wings or extensions of any kind tend to vibrate with periods different from the main mass. The roof should be as light as practicable, and with this in view is built of low pitch and provided with a truss in which the basal tie members are made especially strong. Roof and floors should alike be firmly anchored to the walls and extend completely through or over them. All projecting portions of the building should be made as light as possible and anchored to the main structure. Staircases being liable to individual motions should

FIG. 5. THE MEMORIAL ARCH AT STANFORD UNIVERSITY AFTER THE CALIFORNIA EARTHQUAKE OF 1906. THE ARCH HAS LOST ABOUT A FOURTH OF ITS HEIGHT. (AFTER R. L. HUMPHREY.)

FIG. 6. COLLAPSE OF THE THIELE BUILDING DUE TO LACK OF PROPER TIE BETWEEN WALLS AND FLOORS. CALIFORNIA EARTHQUAKE OF 1906. (AFTER R. L. HUMPHREY.)

be especially braced to prevent their falling and crashing through other parts of the structure. Within the building, chimneys should be bonded and laid in cement mortar, whereas where they project above the roof they should be cemented by weak lime mortar, since in any heavy shock they are sure to be wrecked and will cause less damage when falling in parts than they would as units. If of small dimensions the building should be made as low as practicable, since its instability increases with the square of its height. Strong verandahs, if well braced and firmly joined to the main structure, may be a source of strength, since they act as light buttresses and so increase the effective area of the base of the building. Corners of buildings are especially apt to be detached and thrown down, and hence may be advantageously supported by buttresses (see Figure 5). If it is found necessary to make use of stiff metal columns in the structure they should be made hollow, since they will thus support as much weight and be more stable. Arch-work is seismically unstable, and in spite of its artistic possibilities should as far as possible be avoided. Window spaces reduce the stiffness of the building and additional bracing must be furnished to the frame in proportion to their number.

WATER AND SEWER SERVICE. The history of destructive earthquakes has a monotony in its mention of conflagrations which so generally succeed to the initial damage from the shocks. In rural districts the upsetting of stoves and chimneys, and in modern cities the added menace from electric currents in fallen wires, make it of the utmost importance that every precaution be taken to protect the com-

munity from this danger. The really great losses in the city of San Francisco consequent upon the earthquake of 1906, may be largely ascribed to the rupture of the water mains on the line of the great fault and the resulting water famine in the city. This terrible experience teaches that the different reservoirs which supply a city with water should, if possible, be situated in different directions, so that all will not be likely to be cut off from the city by movement on a single fault:

To protect the water supply of a city further, Derleth recommends that where important water mains cross known fault lines, or pass through marshy or made ground, they should be constructed of riveted wrought iron or steel, have flexible joints at intervals, and be lodged in tunnels of reinforced concrete. Some of the danger from conflagrations may be averted by increasing the number and capacity of the distributing reservoirs within the city.

For sanitary reasons the main lines of sewers should be protected by flexible joints at frequent intervals and enclosed in tunnels in the same manner as the conduits of the water service.

The behavior during the earthquake of the huge dams at the several reservoirs near San Francisco, affords ground for satisfaction in view of the importance of these structures in conserving the water supplies of cities, as well as in protecting the great interoceanic canals. Whether of concrete or of earth, if skilfully and honestly built, they seem to be capable of maintaining their integrity during a reasonably heavy earthquake. The San Andreas dam was directly over the rift line of California, on which large movement occurred during the recent earthquake, but it was not materially damaged, and after the shocks held back the water as well as ever.

THE DESTRUCTION OF BRIDGES. During a heavy earthquake the banks of streams, and of dry valleys as well, tend to approach each other. This can be only partly a result of the lurching of the soil in the direction of the stream, since it is found that railway tracks are shortened and often buckled both over the bridges and in their approaches. The effect of this movement upon a bridge of single span may be: (1) a tilting back of the abutments upon their foundations; (2) a rupture of one or both of the abutments, generally in their upper portions, and a pushing streamward of the separated under portions; (3) a sliding of one end of the girder landward over its abutment; (4) a more or less complete wrecking of the girder and its truss either by local failure or by buckling. These movements all indicate a reduction of the distance between banks and constitute the normal case.

Over a main fault line other movements may equal or exceed in amount those more commonly observed.

To meet the principal danger to the girder and truss, it may in most cases be sufficient merely to provide a longer bridge seat with greater range of motion of the kind provided to meet temperature changes. It might be desirable to provide, in the upper portion of abutments, a horizontal plane of special weakness, so that under earthquake shocks the abutments might part on this plane and relieve the stress upon the girder.

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LABOR COSTS IN THE CENTRAL STATION.

By Howard S. Knowlton.

In this article Mr. Knowlton analyzes the working results of nine characteristic plants, and traces the influences affecting the economy of central-station operation, by the testimony of actual figures.—The Editors.

IN the great majority of steam-driven central stations the cost of fuel is the largest element of generating expense. It is natural, therefore, that efforts to improve the economy of production should be directed against losses primarily due to the operation of the main and auxiliary equipment between the coal barge or car and the station bus-bars, and that separate studies of other elements of manufacturing cost should often assume secondary places in the minds of engineers responsible for the showing of plants in commercial service. Experienced managers realize, however, that while it is an excellent plan to pay the most attention to the items of station expense which lead the rest in magnitude, the combined savings sometimes possible in items of less individual importance amount in the long run to more than the immediately practicable economies in the largest element of running expense. Thus, in one recently visited station, a saving was made in the cost of fuel to the extent of about $2,000 compared with the previous year, reducing the fuel cost per kilowatt hour from 0.712 cents to 0.618 cents. This was a good showing in view of the fact that the output in the second year was 170,000 kilowatt hours greater, and the economy secured was largely traceable to improved equipment conditions. An interesting saving of still larger significance was made in the maintenance cost, the total sum saved being about $8,500 through reductions in the three items of building, steam equipment, and electrical machinery repairs. The unit saving in maintenance was about 0.26 cents per kilowatt hour generated, showing that by paying special attention to the smaller factors of repair cost, the aggregate saving to the station in both total and unit cost exceeded the increased economy possible in that year through improvements in the actual fuel-using and energy-translating steps between the coal pile and the switchboard.

The most important of the items of production cost in a modern central station, after the fuel expense, is usually the labor account per

unit of output. On account of the personal equation and the differences in plant design in various localities, it is far from an easy matter to determine what is a fair allowance for a plant payroll until the local conditions are analyzed. The character of the load variations throughout the day, the design of apparatus units with respect to necessary adjustments and oiling in operation, the possibilities of supervision from a central point in the engine room, the compactness of the station, its symmetry of organization, provisions for emergency service, prevailing scales of wages, and the presence or absence of automatic equipment in the boiler, engine, and pump divisions, all have an important bearing on the advisable personnel. In spite of these various conditions, however, there are two points of cardinal significance in the work of obtaining a low labor cost for a plant of given equipment or for a station of constantly expanding output. The secret of economy in labor in a plant whose equipment is temporarily established at a definite capacity is to run the station at the highest possible output consistent with the giving of reliable service.

An example of what increase in output will do is afforded by a station whose total kilowatt hours generated and delivered at the busbars in one year showed 930,000, and in another year about 1,470,000. In the first year the plant was operated by three engineers and three firemen, at a cost of 0.56 cents per kilowatt hour for station wages. In the second year the force was increased 33 1-3 per cent by the addition of another engineer and another fireman. The total labor cost was $1,600 greater in the second year, but the wages cost per kilowatt hour delivered at the bus fell to 0.46 cents. Experience shows that when a plant is underloaded the output per attendant in the boiler and engine room may frequently be increased by a large percentage without any additional expense in wages, except in the line of slightly increased repairs or a tendency in that direction. This point lies near the heart of the economy of the cultivation of a day load by central stations, and justifies the making of a low rate in many instances for off-peak business, so-called. Fixed charges cannot be reduced by shutting down apparatus, except in the case of depreciation; and it is problematical how far it pays to let a machine stand still to avoid deterioration, since an idle unit requires frequent care to prevent a certain loss of condition, and thereby entails a labor expense if a species of decadence is to be escaped. The cost of producing energy at times when the load is light amounts to little more than the fuel and supplies required.

The second point of economy in a station where the load conditions are changing in such a way that larger units may be substituted for

a number of smaller machines, is found in the decreased labor requirements per kilowatt of capacity as the size of generating sets grows. The question is frequently asked, "How many kilowatts of machinery can one man handle, or what is the point at which the capacity of the station requires additional attendance?" It is almost impossible to answer either of these queries categorically, on account of the differences in local conditions which have to be taken into consideration. The actual limit of machine capacity that can be handled by one man in a turbine station, for instance, does not seem to be reached as yet. A single oiler on each watch holding a second-class engineer's license can look after the running of a turbo-alternator of 12,000 kilowatts continuous capacity, under the general supervision of a watch engineer who divides his time between all the units that may be in service on a given shift. In one plant equipped with several units of the above size, one oiler looks after the operation of each unit and its auxiliaries, making a complete round of the apparatus every fifteen minutes. The watch engineer has charge of the throttle and general oversight of the handling of the unit on its steam end. It is probable that a much larger unit would require no additional attendance. In this particular case the station design is favorable to the lowest labor cost, by virtue of the fact that all the auxiliaries are located in the turbine room, each unit having its own condenser, circulating, dry and wet vacuum pumps. On its electrical side the operation of such a plant is handled by one man per watch, who is, of course, subjected to general supervision, but whose detailed duties confine him to a remote-control switchboard where all the units in the station are electrically focussed. Here again the question of station design has an important bearing on the number of men actually needed to manipulate the equipment. The first cost of the remote-control installation is high, but it cuts the switchboard labor to the lowest terms of quantity. In the above plant the labor cost per kilowatt hours manufactured is less than 0.20 cents, and would probably run still lower if the equipment did not include six reciprocating-engine units originally installed to handle the load, with a hand-operated switchboard in the older section of the station.

In the table opposite some labor costs and details are presented for a number of central stations of varied capacity, with ensuing comments upon the equipment and total cost of production for the period covered, which in each case represents a year's operation.

Although the number of plants tabulated in the table is rather too small for drawing wide conclusions as to the relation between capacity and labor cost, it is evident that, in general, as the plant decreases in

size the operating wages per unit of output rise. This rise is undoubtedly due to the fact that the smaller stations are obliged to install generating units of small capacity, in order to secure reasonable loading on machines in service and also to avoid unreliability and too great initial cost of plant. It requires a larger force per kilowatt of machine capacity to handle a station equipped with a number of small machines than to operate an installation composed of a few large units. Here has been a source of improved economy as the older moderate-capacity central stations have thrown out their belted and line-shaft equipment, substituting a few machines of the direct-connected type for a multiplied number of low-capacity units scattered over a considerable station area. These points apply to many industrial power-plant installations as well as to central stations. Centralization and compression of capacity is a wise policy.

TABLE OF LABOR COSTS IN SELECTED CENTRAL STATIONS.

Plant	Appx. K. W. Rating	Total Station Wages	K. W. H. Manuf'd	Labor Cost Per K.W.H. Cents.	Total Mfg. Cost Per K.W.H. Cents.	No. Station Employees
A	6,000	$25,937	8,776,165	.296	$1.21	22
B	5,000	20,920	6,043,204	.346	1.23	20
C	4,000	19,429	5,400,192	.36	1.24	28
D	2,000	9,954	3,288,623	.302	1.42	11
E	2,000	9,663	4,305,003	.224	1.27	13
F	1,250	6,844	1,470,066	.465	1.56	8
G	950	8,771	1,479,898	.595	2.05	7
H	700	6,669	889,760	.750	2.34	8
I	630	5,017	730,458	.685	1.80	6

Further light may be thrown upon the labor requirements of the foregoing plants by a brief *résumé* of the equipment and number of attendants needed in the operation of each station. Plant A was operated with 6 engineers, 8 firemen, and 8 engine-room and switchboard attendants, in the total 24-hour day. The generating equipment consisted of six 125 horse-power, two 350 horse-power, and four 400 horse-power boilers; one 1,000 horse-power and three 900 horse-power engines, horizontal compound condensing type; and two 1,500-kilowatt steam turbines of the vertical type. There were fifteen generators in the station, a considerable number of them being belt-driven. The station design at the time the figures were taken was clearly unfavorable to economy of labor, but the large volume of plant output saved the day for the wages cost per kilowatt hour generated.

Plant B is a well-designed modern station with direct-connected machinery of economical type. It had six 400 horse-power boilers; one 3,000 horse-power, one 2,250 horse-power, and two 750 horse-

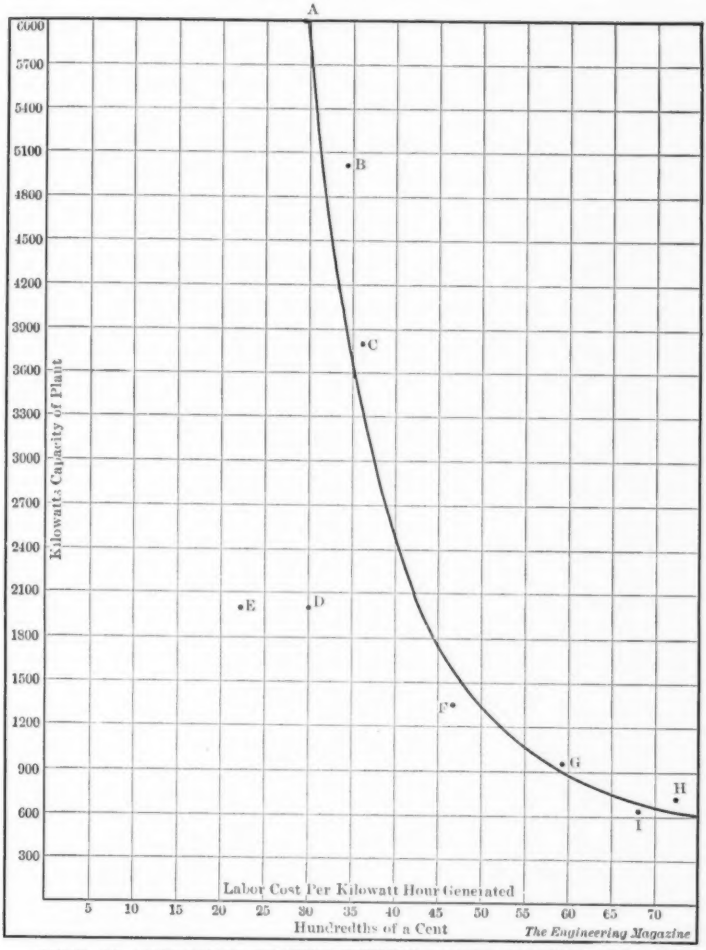
power engines, all of the vertical cross-compound condensing type, built for first-class economical service. The attendance consisted of a total of 4 engineers, 3 oilers, 1 wiper, 4 switchboard men, 6 firemen and 2 coal passers. The indications are that this plant is somewhat over-manned.

Plant C is a station in process of evolution from the belt-connected to the direct-coupled stage, with the transformation largely accomplished. The fire-room equipment consisted of twelve 250 horse-power boilers, hand-fired, and in the engine room were one 1,500-kilowatt vertical turbo-alternator, one 300 horse-power, one 600 horse-power, one 1,200 horse-power, and one 1,800 horse-power, cross-compound horizontal condensing engines. The total number of electric generators was eleven, four being used, however, temporarily, for arc service. The station force consisted of a total of 4 engineers, 5 firemen, 16 engine room and electrical operating men, and 3 machinists. The size of this force is undoubtedly due to the design of the station, which is such that the plant covers a large floor space and is also electrically subdivided so that not all the switchboard apparatus can be covered from any one point.

Plant D is a station of almost the same design as plant B, but of much smaller capacity. The labor requirements have been very carefully worked out in this station, and the results show it. The operating force consisted of 4 engineers, 3 oilers, 3 firemen, and 1 helper. The plant had five boilers of 258 horse-power each, and the following generating units, all direct connected; one 600 horse-power engine, one 900 horse-power engine, and one 1,500 horse-power engine, all vertical cross-compound condensing units. The switchboard is a compact hand-operated structure centrally located on the floor of the engine room. The boilers are hand-fired.

Plant E is a central station whose principal load is furnished by an adjacent street-railway system. There were 3 engineers, 3 firemen, 2 coal passers and 5 helpers. The boilers were one 125 horse-power, and nine 150 horse-power units, and the engine sizes were two 400 horse-power simple engines, and one 100 horse-power, one 1,250 horse-power, one 200 horse-power, and one 800 horse-power compound condensing units. There were fifteen generators. The large output of the plant in relation to its capacity, combined with a comparatively small station force, brought the cost of station labor down to an excellent figure for a plant of 2,000 kilowatt rating.

Plant F had four boilers aggregating 1,000 horse-power and three horizontal cross-compound condensing direct-connected engines rated respectively at 240, 450 and 1,000 horse-power. Four engineers



CURVE OF APPROXIMATE RELATION BETWEEN STATION CAPACITY AND COST OF WAGES.

and four firemen operated the station. The conditions were favorable to economy of labor, but the plant was handicapped by a small yearly output, being located in a suburban town where there was little opportunity to develop a substantial motor load.

Station G was an installation of combined engine and steam-turbine equipment, well maintained, but composed of moderate sized units of both belted and direct-connected type. Four boilers of 678 total rated horse-power supplied the steam in this station to two

horizontal cross-compound condensing engines of 175 and 350 horse-power and a 500-kilowatt vertical steam turbo-alternator. The operating force consisted of 3 engineers, 2 firemen, and 2 electrical attendants. Scattering of the station capacity and the handicaps of moderate output were the chief factors in raising the unit labor cost.

Station H was another small installation composed of three horizontal cross-compound condensing engines rated at 250 horse-power each and a 211 horse-power simple engine. There were four boilers aggregating 600 horse power in capacity. The station was operated by 3 engineers, 2 oilers and 3 firemen. The total yearly output was too small to enable much economy of labor to be enjoyed.

Plant I was equipped with three engines and six generators, with a liberal proportion of belted units. There were three boilers aggregating 550 horse-power. All the engines were of the cross-compound condensing type, two being rated at 250 horse-power, and one at 125 horse-power. Three engineers and three firemen operated the machinery. High unit cost was again due to the small load the year through.

The curve on the preceding page shows the approximate relation between station capacity and the cost of wages at the plant per kilowatt hour as experienced. Plants D and E are doing much better than the average and indicate what may be accomplished with even a medium capacity installation. In conclusion, a table is shown, giving the approximate kilowatt per station employee and the station wages per kilowatt capacity for the year. In general it appears that the larger the plant, the better the opportunity for obtaining a low labor cost and increased capacity per attendant.

TABLE OF PLANT CAPACITY AND LABOR COST.

Plant	Approx. K. W. per Station Employee	Station Wages per K. W. Station Capacity
A	272	$4.31
BB	250	4.18
C	136	5.10
DD	182	4.97
E	154	4.83
F	157	5.45
G	136	9.25
H	87.5	9.52
I	105	7.95

About three times the above listed kilowatt capacity per station employee is handled on each actual watch, assuming three shifts per day.

GRAPHICAL HELPS FOR APPORTIONING TIME IN CONSTRUCTIVE OPERATIONS.

By Herbert F. Stimpson.

Mr. Stimpson's contribution is an earnest and well supported argument of the *necessity* (not merely the utility) of using methods for apportioning time closely similar to those used in apportioning material. His suggestion deserves the thoughtful attention of all students of production costs, and especially of the reduction of costs.—THE EDITORS.

IN considering any line of human endeavor, the attention of the analyst is often arrested by curious and hitherto unrealized defects in the methods which are employed in the accomplishment of the desired ends. The work of discovering and remedying these defects in constructive operations of all descriptions is one of the most interesting duties of the industrial engineer, and the defect which is the subject of this article is the illogical difference between the graphical helps in the shape of recorded thought given to men to assist them in the apportionment of material, and those given for a similar purpose as regards the apportionment of time.

I desire to state most clearly, at this point, that in the light of many years' experience I am convinced that this defect is common to nearly all constructive operations. I shall, therefore, discuss this defect entirely as regards its general character and not as regards the specific details, which must necessarily vary with the particular work in question.

In investigating this phase of constructive work we shall find that it is considered quite a matter of course that expert designers (to use a very comprehensive term), draughtsmen, and other assistants should be employed to prepare variously named assembled drawings, detail drawings, memoranda, and lists which are intended to indicate with great exactitude, first, the original condition of the (relatively) raw material, and finally, the exact shape and size into which it is to be converted. The expense of this work, which is often great, is considered to be entirely justified by the resulting economy in the use of material, to say nothing of the unavoidable necessity of constructing an article on paper prior to attempting to do so with other material even for the purpose of a model.

But how about similar conveniences when it comes to dealing with the irreplaceable element of time? The situation may be ludicrously illustrated by comparing it to an attempt to clothe a man having two legs with trousers from which one leg is missing. One leg, material, is taken care of by the designers and draughtsmen and gets along nicely; but how about the other leg, time? This is destitute of protection and suffers accordingly. The situation is, however, far too serious for joking, as those who have analyzed the matter know beyond all doubt.

But, it will be said, have we not cost accountants and time-recording systems without end, and do not some of these remedy the evil if, indeed, it exists? I have no hesitation in saying that in all except a very few cases they do not even touch it, because they work on a basis of retrospection instead of prospection.

In regard to material the conditions of the problem arbitrarily determine, in advance, certain principal distances, centres, etc.; from these certain subordinate points are logically determined, and around both of the above the detailed parts of suitable shapes and dimensions are assembled; first, it may be, into groups, and finally into the perfect whole. The method of procedure here is, obviously, from a knowledge of an entirety, by logical processes, to a knowledge of details.

In regard to time we must work in the other direction, on account of the difference in the conditions which exist at the commencement of our work. In this case we do not know the limits of the entirety. These must be determined, by logical processes, from a study of details.

In apportioning the amount of material for each detail great care is taken, in advance, to determine just how small an amount will safely and certainly satisfy the demands which are to be made upon it. But why should not the time for performing each operation on these details also be determined, in advance, and with equal care?

In purchasing the raw material great care is taken, in advance, to purchase only just such quantities and individual pieces as will allow of conversion into detail with the least waste. Why should not the quantity of productive time represented by different types of men, machinery, or apparatus also be determined, in advance, and with equal care?

As regards material great care is used in determining, in advance, the necessary clearances between parts, either because some of them

are movable or to facilitate construction, and so as to allow just enough and no more. Why should not the clearances between the successive different operations on the same piece of material, and also between successive similar operations on similar parts of different contracts or orders, be determined in advance, and with equal care?

It is just as possible and as vitally necessary, to draw, to represent with lines, to make a graphic record, of the results of the observation, thought, and calculation whereby the time which *should be,* not the time which *is,* consumed in the performance of each individual operation is determined, as to draw the part itself. It is equally possible and as vitally necessary to draw the time which should be required to produce each subordinate group, and also the entire object which is to be constructed; and not only that, but the relations between the times required for the production of all, if more than one are being simultaneously constructed.

In the case of material, also, the various processes by which drawings can be easily and accurately reproduced make it possible for large numbers of persons, though widely separated, who are variously interested in the work, to co-operate understandingly to the common end. Can one possibly imagine such people, even with duplicate copies of a reasonably clear description of the work to be done, accomplishing their work successfully or at all without drawings—those wonderful representations of something which, when the drawings are made, is often entirely non-existent? Yet, when it comes to securing co-operation in matters of productive time, is not that just what employers are asking each other and the men under them to do?

Is it any wonder that men are blindly switched from one thing to another, thus wasting effort and time; that some apparatus or machinery is largely idle while others are continually overloaded; that it is the same in the case of men; that shipments of material and merchandise and the performance of large operations in the field are often greatly delayed with corresponding loss, and that executives of all grades are seriously overworked in trying to keep promises that, after all, are simply founded on guess work? Is it not, rather, the wonder that we accomplish as much as we do?

But would it not be infinitely more satisfactory all around if time were handled as certainly and surely as material, which is entirely possible?

And yet—and yet—though it would seem as if they *must* see that something is wrong, or at least, incomplete, do the men who suffer most from this incompleteness eagerly embrace an opportunity to

progress when it is offered them? No! It is with the greatest difficulty that they can be got to listen, even in the most half-hearted way, to a statement of the facts; they reluctantly assent to an extremely limited demonstration in connection with their own work, and they angrily repudiate the statements of the leaks which are found. Would a sea-captain do the like to one bringing him news of a leak in his ship?

The first step towards the scientific apportionment of time is the determination

a. by men who are specialists in the art;
b. using scientific methods;
c. with scientific accuracy

of *standard times* for the performance of each individual operation, whether it is shoveling dirt, laying bricks, driving rivets, turning shafts, or what not.

Around this work is centered the tremendously important other work of maintaining these standards in actual practice. So far as the employees are concerned, their failure to maintain the standards, about 25 per cent of the whole, results from two things; ignorance of ideal methods of working, and failure to put forth proper effort from lack of proper incentives. So far as the employer is concerned, his failure to maintain standards, about 75 per cent of the whole, is due to non-appreciation of the waste of the present methods; hence, and perhaps not altogether unreasonable, his reluctance to incur the expense of new methods, be the cost of doing so ever so slight in comparison with what would be saved.

The profits that have already been derived from the determination and maintenance of these standards are almost beyond belief, yet they are *facts* and they are derived from what is, after all, simply a closing up of the gaps in the operative time of men and apparatus, so far as the minute subdivisions of individual operations are concerned.

Why, therefore, should not an effort be made to close up the gaps between the operations? It is true that methods have been devised whereby operations, noted on cards bearing the names of individual workers or squads, can be distributed in advance on convenient racks or boards thus planning the work somewhat in advance. But this method, it seems to me, does not fulfill all the requiremenst in the case. We wish to know not only the time that will be necessary for the completion of the operation and of the entire work. but also the sequence in which each part and group must be begun in order that they may combine at the proper times and in the proper sequence, so

that the whole work may be finished at the time which is desirable or has been agreed upon.

We also wish to be sure that when filling more than one order or contract simultaneously we are not counting upon the use of any money, man, machine, apparatus, transportation facility, etc., for more than one item, or its capacity, at any one time.

That two trains cannot pass each other upon the same track without dire disaster is well realized, but much less so that a similar attempt in constructive operations will bring about similar results. Yet one cannot pay two bills of ten dollars at the same time with one ten-dollar note; a mason cannot lay bricks on two walls at once; a lathe will not simultaneously turn two shafts, or a horse draw two loads in different directions; yet that is what, so to speak, is being attempted more or less, every day, for lack of the helps of which I speak.

It may be said, what I well know, that it is extremely difficult to carry out a predetemined program for any considerable length of time, but this, in many cases, is simply an excuse for inaction. What navigator when caught in a storm, with sun and stars obscured, would fail to keep as careful a record on his chart as possible, even if only by dead reckoning, though he would not fail to take advantage of the first clear sky to get an observation whereby he might correctly determine his position? The best of methods will fail at times, not because the method is wrong but because its provisions are not carried out. If the performance fails to keep up with the chart, the chart enables us to measure our error, if we have the courage, to know the truth and to readjust our plans accordingly.

When a client complained of the difficulty of readjusting the chart he was asked if he realized that the chart was only the representation of the things that he could not escape readjusting, and that by getting a comprehensive view of them on the chart the work was made far easier.

The determination of standard times is an accomplished fact upon which to build in determining the apportionment of time in advance and in properly recording it for the guidance and benefit of those who may be concerned; and the profits from this, in accordance with Emerson's Theory of the Dependent Sequence, will be correspondingly great, as the whole is always greater than any part.

It will take trained men to devise the methods for the individual case; it will take time to do this and more to put it into effect; for it will effect every function of a business and it will cost money; but in spite of all this *it will pay*.

MODERN CYANIDING PRACTICE AND MACHINERY.

By Arthur Selwyn-Brown.

The practice and processes described by Mr. Selwyn-Brown have resulted not only in the profitable working of ores of too low grade to be treated by the older methods, but also in the recovery of large values formerly thrown away in tailings. They are important factors in the enormous increase in gold production which is causing marked changes in economic tendencies and conditions at the present time.—THE EDITORS.

THE solubility of gold and silver in cyanide solutions was known to chemists more than a century ago. No satisfactory attempts to treat gold or silver ores by means of cyanide solutions on a commercial scale, however, were made until 1885, when Messrs. MacArthur and Forrest, of Glasgow, Scotland, began to experiment with cyanide solutions. Their early work was not very successful, but in 1887 they found that low-grade gold ores that were finely pulverized and contained gold in a free condition could be profitably treated by weak solutions of cyanide of potassium. They patented their discovery in October, 1887. A company was then formed in Scotland to exploit the patent, and metallurgists were sent to Australia, New Zealand, the United States, Mexico, South Africa, and elsewhere to secure options to purchase the large heaps of auriferous tailings and sands lying around the principal gold mills, and to endeavour to induce millmen to adopt the process on a royalty basis.

These pioneers of the process met with little success. Only the South African expeditions appeared to offer hope. The company's representative at Johannesburg was Mr. Alfred James, who has since become one of the leading authorities on cyaniding practice. Mr. James succeeded in securing from the engineers of Wernher, Beit & Co., at Johannesburg, an option over a block of 10,000 tons of tailings from the Robinson mines. In 1890, a small cyanide plant was built near the tailings dump to treat the gold-bearing sand. It was a success from the start. A sum of $15,000 had been expended in the plant and initial experiments, and the returns from the first clean-up onward gave a profit at the rate of $10,000 per month. The result of this extraordinary success was that Wernher, Beit & Co. adopted the process for the treatment of the tailings of all their mines, and

the leading operators on the field erected plants as quickly as it was possible to do so. Since those early days the Rand has developed, largely by means of the cyanide process, so as to become the world's leading producer of gold. During the past four years the Transvaal mines have produced over $513,750,000 worth. Gold to the value of $976,000,000 has been mined on the Transvaal since the first monthly clean-up of the Robinson cyanide plant in 1890. The annual yield since 1902 is given in Table I.

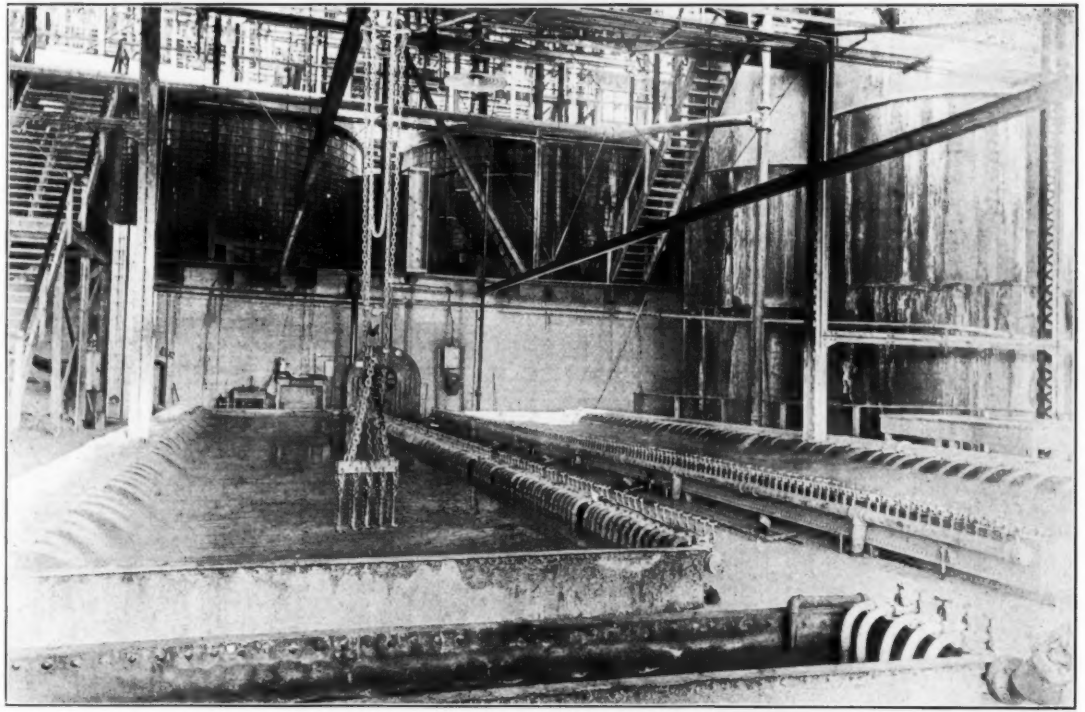
TABLE I. TRANSVAAL GOLD PRODUCTION, 1902-8.

Year.	Tons of ore milled.	Value of gold.
1902	3,416,813	$36,268,325
1903	6,105,016	62,946,240
1904	8,058,295	80,274,045
1905	11,160,422	104,010,370
1906	13,571,554	122,899,935
1907	15,523,229	137,018,690
1908	18,000,000	149,850,000

In addition to the large tonnage of ore treated annually by the cyanide process in South Africa, an immense tonnage of both gold and silver ores is treated on the leading mining fields of the world. No improvements in the metallurgy of gold and silver made in recent years are comparable in importance with the cyanide process. That process is in a very large measure responsible for the great increases in the annual gold and silver yields of the world's mines which have been witnessed during the past twenty years.

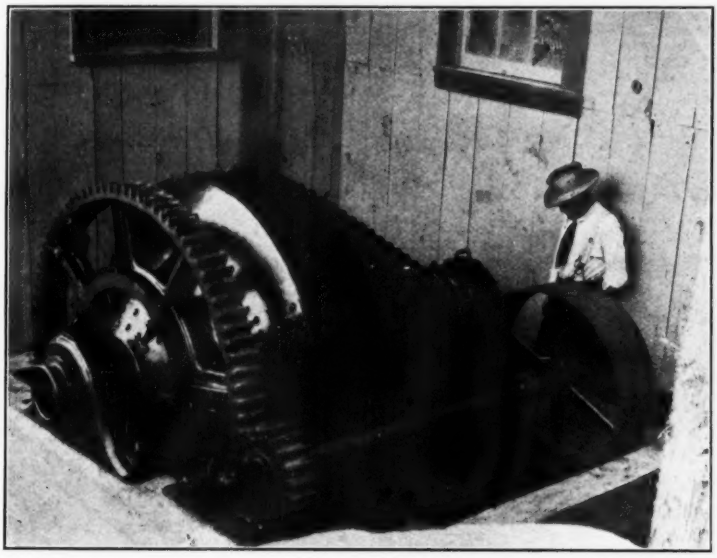
Notwithstanding the widespread development the cyanide process has undergone since its successful *début* at the Robinson mines, the chemistry of the process has undergone little change. The Robinson plant consisted of a circular wooden solution tank, containing a 0.25 per cent solution of potassium cyanide, which was connected by piping with a wooden percolation tank, into which the tailings were dumped for treatment, and a sump tank, where the auriferous solutions were stored before being treated in the zinc precipitation boxes.

The cyanide practice at the most modern mill on the Transvaal or Nevada goldfields does not differ in principle from that of the early Robinson plant treatment. Weaker cyanide solutions are now used, and in a few instances, other chemicals are added to the cyanide solution to counteract the bad effects of harmful minerals dissolved with the gold from the ores by the cyanide solution. But while the chemistry of the process has not changed, the detailed treatment has been revolutionized during the past few years. Wonderful improvements have been made in the mechanical appliances used in cyaniding.



INTERIOR OF THE CYANIDE PLANT, GOLDFIELD CONSOLIDATED MINES COMPANY, SHOWING CYANIDE VATS AND BUTTERS FILTERS. The steel filter boxes are 61½ ft. long by 10 ft. wide. The operations are controlled by levers and hand wheel seen in the background.

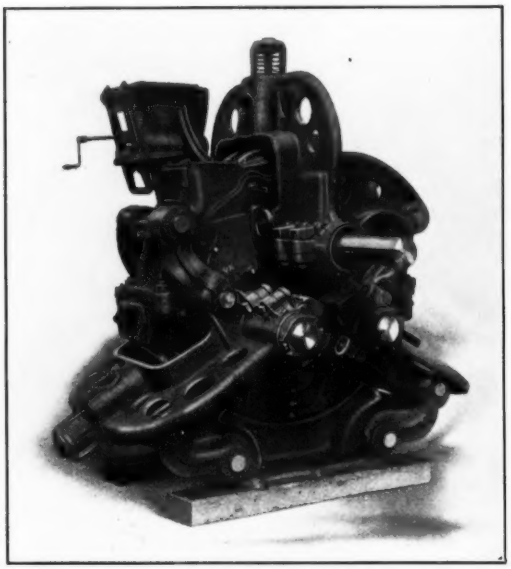
Cyanide vats are now constructed on a large scale of steel and concrete, in place of the small wooden tanks used in former years. They are elaborately furnished with automatic machinery and appliances for charging and discharging the tailings, and for handling the various solutions. These developments have resulted in reducing the time occupied in getting the gold into solution to a minimum, and, consequently, in lowering treatment costs to very moderate figures.



HARDINGE CONICAL MILL INSTALLED AT THE COBALT CENTRAL CONCENTRATOR.
The Hardinge Conical Mill Co.

Fine Grinding.

It is essential for rapid treatment that the cyanide solution be brought into direct contact with the gold. This can only be done by crushing the auriferous material as finely as possible. This was formerly done in stamper batteries and grinding pans. The coarse gold was extracted by amalgamation on copper tables, and by re-grinding the sands in fine crushing pans. Fine grinding is today done in a variety of mills of large capacity. Huntington, Bryan, and Hardinge mills are extensively used for that purpose. They are steel mills that have been developed from the early appliances of Spanish miners. Thy are so well-known that it is unnecessary to do more than mention them here. The latest type of Hardinge mill is shown above.



THE MAXECON MILL.
Operates on principle of a free vertical concave ring, yieldingly supported on three rolls pressing against its inner face and having free movement relative to each other. Kent Mill Co.

Ball mills, which have been largely employed in chemical works, are used in some mining districts for finely grinding ores. The Krupp type of mill sometimes gives satisfactory results. Ball mills have, however, not been found suitable for heavy work in many cyanide mills.

Lately the old Chilean mill has been improved so as to do work that challenges comparison with other types of modern fine ore crushers. In some recent tests of Chilean mills, working against stamper batteries and tube mills on quartz from mines at Pachuca, Mexico, the Chilean mills showed up well.* The main results of the tests are summarized in Table II.

TABLE II. COMPARISON OF CHILEAN MILLS WITH STAMPS AND TUBE MILLS.

	5 Chilean mills.	25 stamps and 2 tube mills.
Capacity to 150 mesh.....	100 tons	100 tons
Cost of mills and power plant..	$24,000	$17,000
Weight of mills and power plant	195 tons	127 tons
Power required.....	46 h.p.	95 h.p.
Wearing parts renewable.....	Every 2 years	Every 3 months

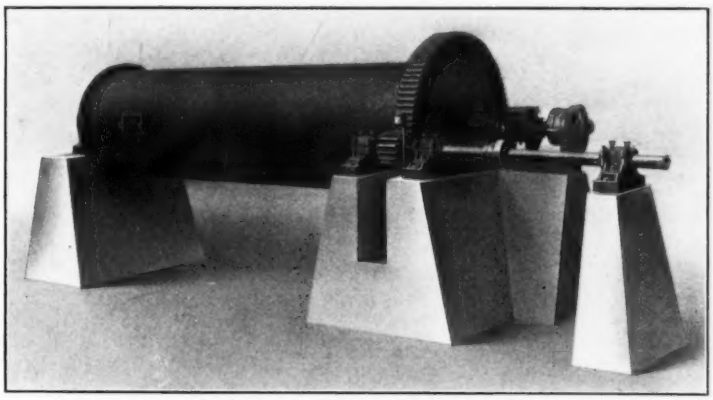
The tube mills following the battery were 3½ feet by 14 feet in length. The stamps each weighed 1,050 pounds. While the first cost of the Chilean mills was higher than that of the battery and tubes, there was much less power required for driving them, and

* See the *Engineering and Mining Journal*, June 12, 1909, page 1182.

they showed wonderful economy in wearing and repairs. All the above-named mills have their advocates. The most widely favored fine crusher for cyanide work today however is the tube mill. The application of the tube mill, and vacuum filters to be described later, constitute the two leading improvements in modern cyanide practice.

Tube Mills.

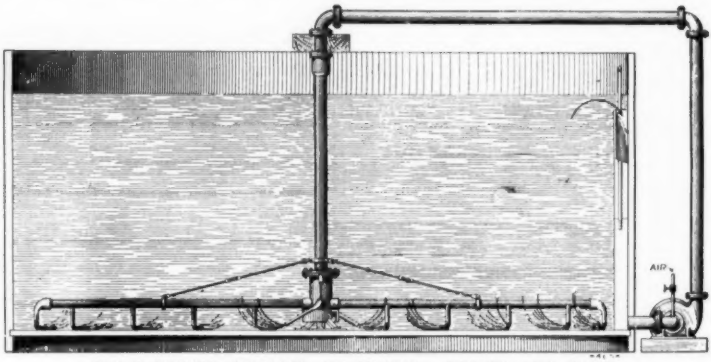
Tube mills range in size from 14 to 18 feet in length and 3½ to 4½ feet in diameter. They are usually cylindrical in shape, but some are conical. They are loaded with from 5,000 to 6,000 pounds of flints, or other stones, and driven at speeds ranging up to 40 or 50 revolutions per minute. They usually require about 20 horse power to drive them.



A TYPICAL TUBE MILL ON ITS FOUNDATIONS.
Made in three sizes—4 ft. by 16 ft., 5½ ft. by 20 ft., and 6½ ft. by 20 ft. F. L. Smidth & Co.

The greatest wear in tube mills is, naturally, on the lining. Much attention has been given to means for reducing the wearing down of the lining. With some ores chilled iron liners are used. On the Kalgoorlie field, Australia, chilled-iron liners are employed and they give about six-months service. In some American mills cast-steel lining is used. The latest practice in most mining districts, however, favors the use of pebble lining. The New Zealand mills are equipped with linings composed of cast-iron segments curved to the shape of the tube. The segments are sub-divided into honeycomb-like frames, in which stones are fixed in a cement matrix. The stone crushing surface is made by pouring Portland cement into the honeycomb frames and jamming rough stones and pebbles into the cement. Quartz, flint

and other hard stones are employed for setting in the cement. Whenever any part of the stone lining becomes worn down, the frame or frames involved are chipped out and a new setting of fresh crushing stones is made. The cast-iron segments have to be renewed at intervals varying between six months and a couple of years according to the nature of the material crushed.

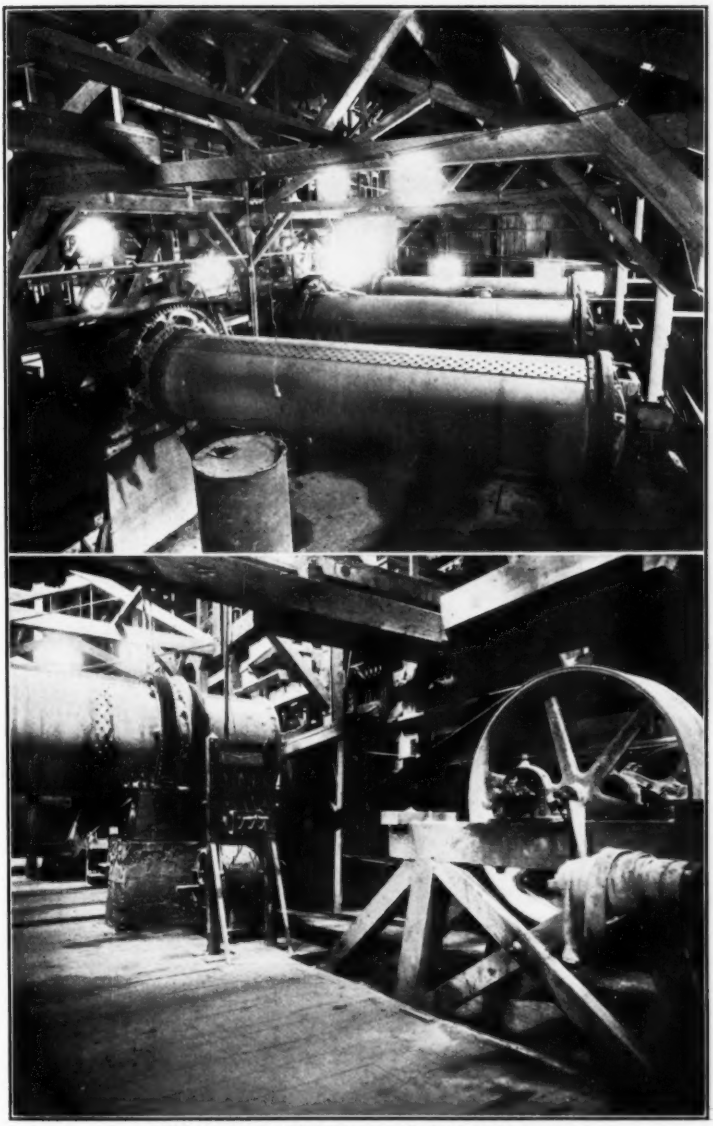


TRENT IMPACT AGITATOR, CIRCULATOR, AERATOR AND MIXER.
Traylor Engineering Co.

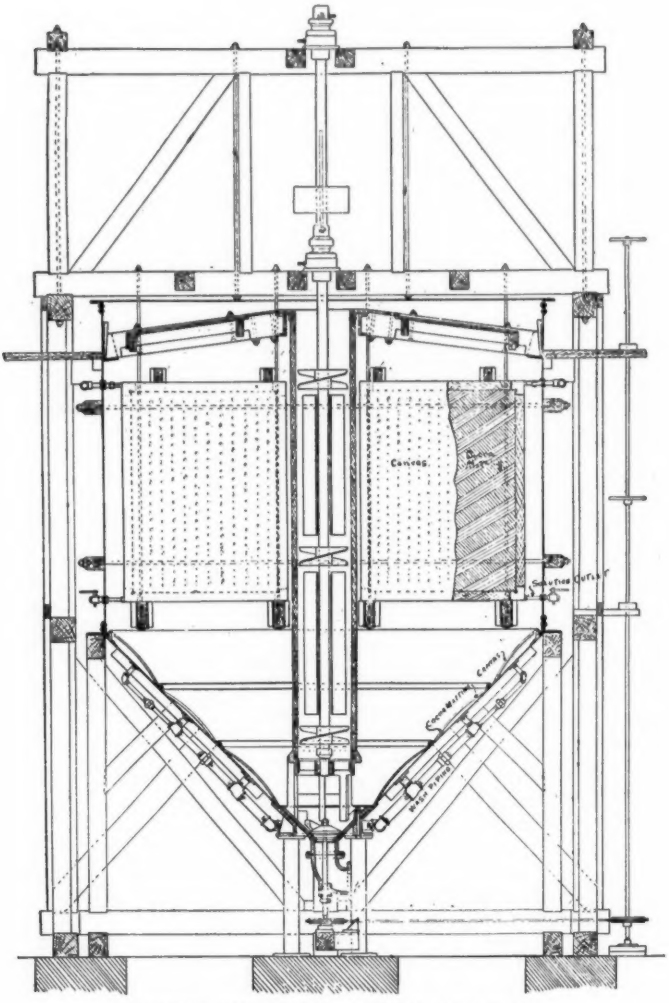
In some of the Mexican tube mills a ribbed lining is used instead of the New Zealand type of cast-iron or steel lining. Iron or steel bars are cut and formed into ribbed segments. The segments have bolts countersunk into their outer surfaces. The free ends of the bolts are passed through the steel shell of the tube and are capped by nuts to secure the segments to the tube. Quartz pebbles are set between each parallel pair of bar segments, as in the New Zealand type of lining. These iron-bar segments last as long as the cast-iron ones and are much lighter. They consequently lead to economies in the driving power required to operate the tubes.

Agitation and Aeration.

In order that the gold in a finely ground product from tube, or other fine-grinding mills, may be quickly brought into contact with the cyanide solution, it is necessary to agitate the solution tanks. This is done in a variety of ways. The simplest method is to have the tanks equipped with a revolving spindle furnished with stirrers or paddle bars. The Traylor agitator, made by an American firm, consists of a tank containing a suspended pipe connected with the discharging orifice of a centrifugal pump. The bottom of the pipe contains a double T connection fitted with four smaller pipes arranged at



TUBE MILLS INSTALLED IN COLORADO GOLD MILLS.
Above, an installation of 5 by 23 ft. trunnion-type tube mills, U. S. R. & R. Co., Colorado Springs; below, 5 by 22 ft. tire-style mills, Liberty Bell mine, Telluride.
All by the Abbé Engineering Co.



HENDRYX COMBINATION AGITATOR AND FILTER.

right angles like the spokes of a wheel. These small pipes contain a number of small jet pipes which are inclined toward the bottom of the tank. When the pump is set in motion it draws the cyanide solution from near the top of the tank, through a small valve, and forces it

back again into the tank through the suspended pipe and out through the jets in the smaller pipes at the bottom of the tank. The pressure of the pulp as it is discharged from the jets causes the agitator pipe arms to revolve slowly. The pulp flowing from the jets stirs up the pulp clinging to the tank bottom. This is a simple and effective mechanism for agitating, aerating, and mixing cyanide solutions.

For dealing with large quantities of cyanide solutions an appliance known in Mexico as a Pachuca tank, and in Australia as a "tall tank agitator," is largely in use. It consists of a cylindrical iron-plate tank about 8 feet in diameter and 35 to 40 feet in height with conical bottoms. A pipe, having a diameter of 1¼ inches for each foot of diameter of the tank, is suspended in the center of each tank. The top of this pipe is open and reaches barely to the top of the tank. A small air pipe is run down the center of the suspended pipe as far as the bottom. The tank is filled with the ground ore and cyanide solution. Air is pumped into the small central air pipe and allowed to escape at the bottom of the larger suspended pipe. This air lightens the water-column inside the larger pipe and causes the solution to over-flow the pipe at the top of the tank while fresh pulp is sucked in at the bottom of the suspended pipe. This fresh pulp is carried up the pipe and overflows it. In this way there is a steady circulation kept up throughout the tank, and every particle of ore is constantly turned in contact with cyanide solution and bubbles of air. The tanks are automatically discharged at the bottom by flushing through a discharge cock.

A pulp consisting of 75 per cent of sand and 25 per cent of slime is successfully treated on the Transvaal by the Adair-Usher process. The plant consists of ordinary decantation tanks fitted with conical bottoms arranged in series so that the bottom of the one above is 2 feet higher than the one below. Each tank is provided with an outflow at the bottom and an overflow pipe at the top. The sand and slime are fed to a tank by a distributor placed near the top of the tank. The cyanide solution is run in through a radial distributor situated near the middle of the tank. The pulp sinks in the rising current of solution when the enriched solution flows out from one tank to the solution distributor of the tank next below it and settles on the conical tank bottom. It is collected here and fed by an injector to the pulp distributor at the top of the tank next above. The pulp is finally discharged from the topmost tank. The solution always travels downwards from one tank to another. The solution and sand thus travel in opposite directions.

These various methods of agitation and aeration have enabled metallurgists to treat large quantities of fine, and previously troublesome, slimes, in a comparatively short time.

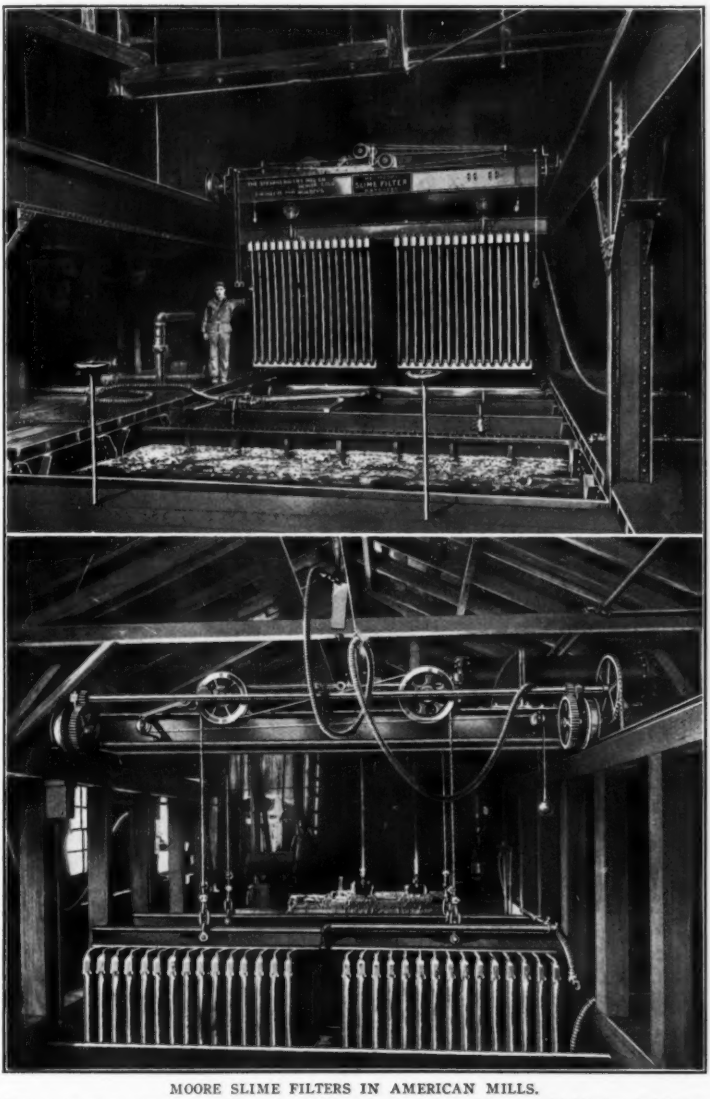
Filtration.

In the early days of the cyanide process filtration was carried out almost solely by simple percolation in wooden tanks. This was always a slow and expensive method of separating the gold solution from the treated material; but it is only recently that better methods have become available. Filter-processing was first profitably tried, and later numerous vacuum filters were introduced into cyanide practice. There are a variety of such filters now on the market. They are all simple, and are mostly of large capacity. The Butters and Moore filters are the most popular ones today. Continuous suction filters of the Ridgway type are rapidly coming into favor.

The Moore Filter.

The Moore filter is composed of a large vat, or tank, into which a filter frame containing numerous filter leaves is let down from a traveling crane above, which is free to travel on steel rails for the full length of the filter. The vats are made of concrete or steel, and are often large enough to hold 300 to 400 tons of pulp. There may be as many as 50 filter leaves with a filtering area of over 8,000 square feet in a frame. Each filter leaf is made of canvas, which is doubled over a frame made of Oregon fir or steel tubing. On the bottom edge of each leaf, a launder for collecting the in-filtered auriferous solution is made of ¾-inch channel iron. This launder is connected by a 1-inch vertical suction pipe with a suction pump.

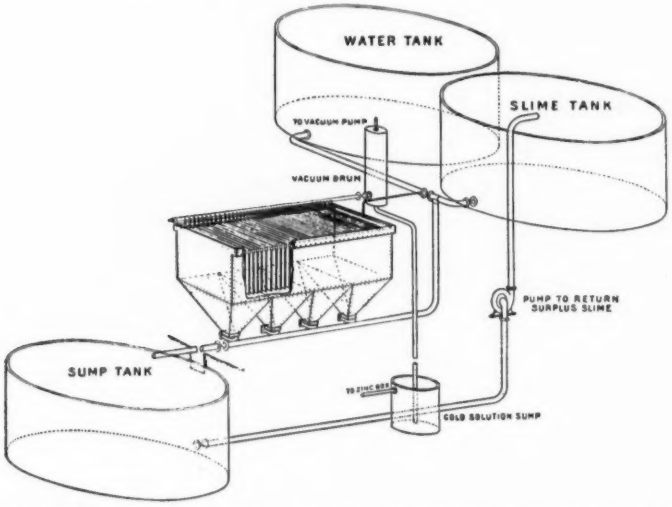
The Moore filter is operated as follows: the vat is filled with pulp. Then the filter frame containing the leaves is brought over it by the traveling crane. The leaves are let down into the vat. When they are submerged in the pulp the vacuum pump is started. The pump draws the auriferous liquor through the canvas and discharges it into storage tanks. Suction is kept up, together with intermittent agitation in the vat, until a cake of slime affixes itself on the outside surfaces of the canvas filter leaves. When this slime cake is thick enough, the filter frame is raised by the electric crane and carried over to a washing vat of dimensions similar to those of the pulp vat, and washed. The frame is afterward suspended over the discharging hopper for a short time until the suction pump reduces the moisture in the slime cake as much as possible. Then the vacuum is shut off and air under a pressure of 35 pounds per square inch is forced into the filter leaves. This



MOORE SLIME FILTERS IN AMERICAN MILLS.

The upper view shows the mill of the Golden Reward Consolidated Gold Mining & Milling Co., operated by an electric crane. Below is the plant of the Ernestine Gold Mining Co., handled by a pneumatic crane.

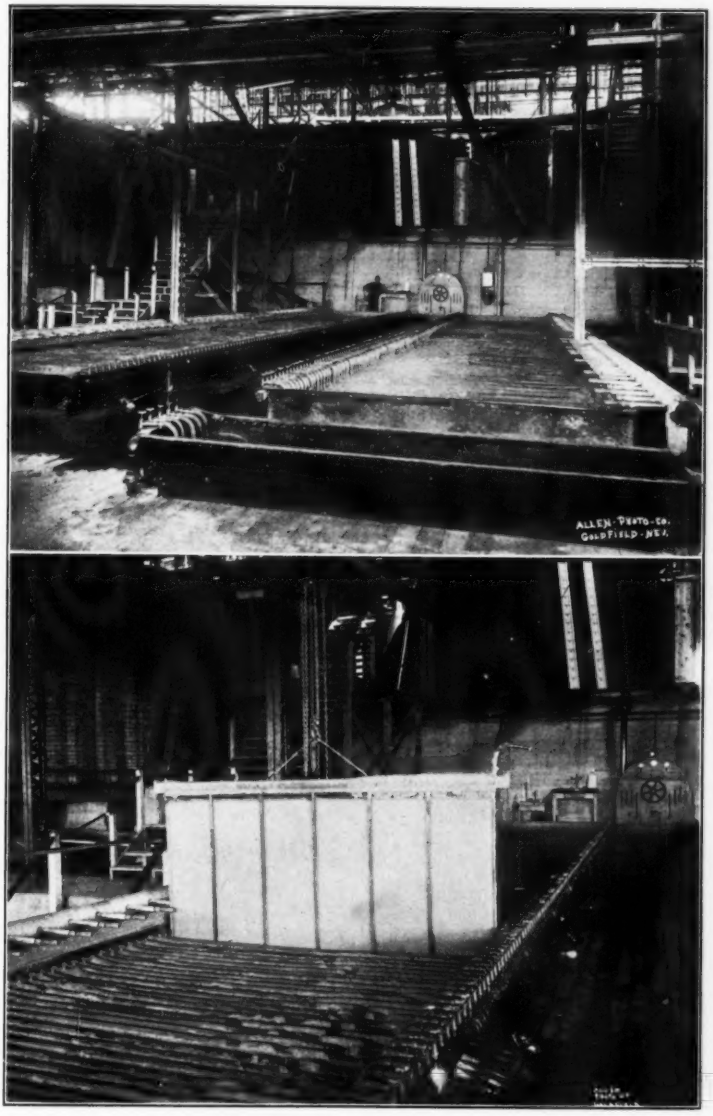
loosens the cake and between 80 and 90 per cent of it falls into the hopper. The remaining portion is scraped off the canvas by hand. Experiments at a new cyanide mill furnished with a Moore slime filter of 300-tons capacity showed the filter was capable of forming a ¾-inch cake of slime in the remarkably short period of 12 minutes, and a 1½-inch cake in 25 minutes. The plant was capable of being successfully operated in 1½ hours. That is to say, the time occupied in filling and discharging the filter, and preparing the leaves and filter for a fresh charge, was only 1½ hours.



DIAGRAMMATIC ILLUSTRATION OF AN ARRANGEMENT OF BUTTERS FILTER AND TANKS, FOR HILLSIDE SITUATION.
Butters Patent Vacuum Filter Co., Inc.

The Butters Filter.

Cassel, of Glasgow, Scotland, inverted the Moore procedure. Instead of having the filter leaves free and moving them about between the pulp vat, washing tank, and discharging hopper, Cassel fixed a number of vacuum filter leaves in a long rectangular tank. From 100 to 200 filter leaves are fitted to a tank. The Butters filter at the Goldfield Consolidated Mill, Goldfield, Nevada, contains 150 leaves and has a capacity of 600 tons per day. This type of filter takes up much less room than the Moore filter, and can be built in very large units.

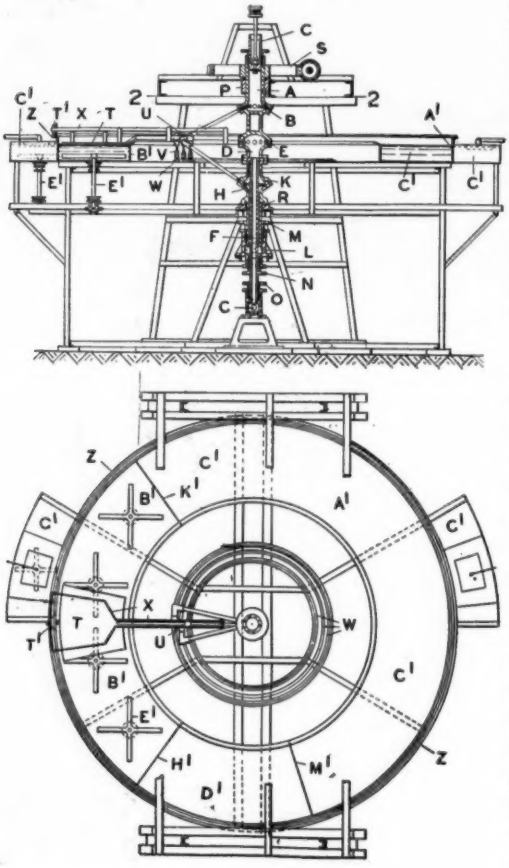


BUTTERS PATENT VACUUM FILTER, GRAVITY SYSTEM IN THE 100-STAMP MILL OF THE GOLDFIELD CONSOLIDATED MINES CO., GOLDFIELD, NEVADA.

The filter consists of two boxes, each containing 168 filter frames (336 leaves). Treats 738 tons of dry slime in 24 hours. Controlled by one man per shift. The upper picture shows a general view from the operating platform. The lower shows a filter frame loaded with 1-inch slime cake.

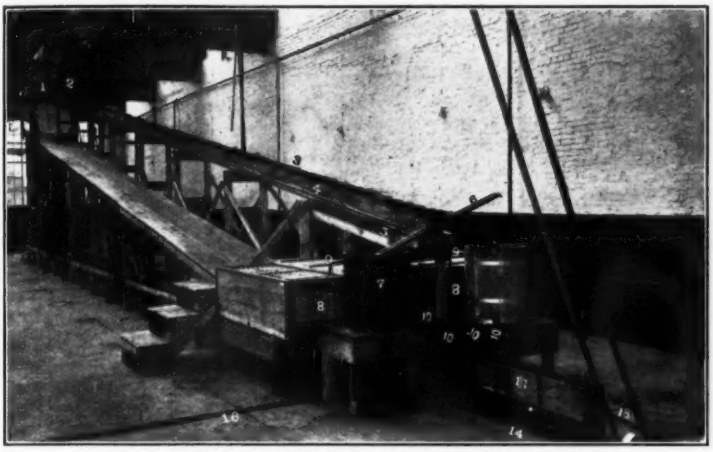
The Ridgway Filter.

The mechanical engineer at the Great Boulder mine, Kalgoorlie, West Australia, several years ago invented a continuous, revolving, vacuum filter which is very successful. Filter leaves are suspended horizontally from radial arms revolving over a cylindrical tank. The suction pipes from each filter leaf are connected with a main pipe attached to the central spindle which revolves the leaves. The tank is divided into three compartments. One compartment is used for the pulp, one contains washing water, and the third is for discharging the slime cakes. As the filtering arms slowly revolve around the central axis, the horizontal vacuum filters alternately pass from one division of the tank to another. Each filter leaf remains about 13 seconds in the pulp vat sucking up the slime and auriferous solution. It then passes to the washing vat where it remains about 30 seconds. Finally it goes to the discharging



THE RIDGWAY FILTER.

T, cast-iron filtering frames; U, nest of three valves, automatically operated; B, compressed-air section of central column; G, L, vacuum connections; B¹, pulp; C¹, wash; D¹, blowing-off section.

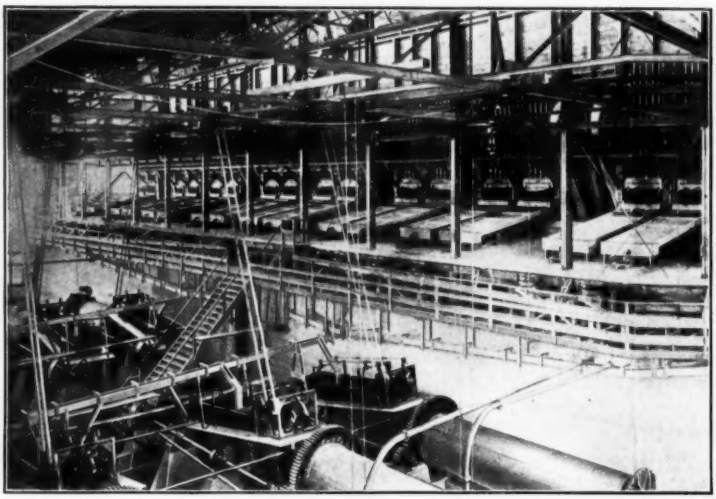


TYPICAL INSTALLATION OF THE IMLAY RAPID CYANIDE PROCESS.
W. L. Imlay Rapid Cyanide Process Co.

vat, or filter division, where the slime cake is blown off the filtering surfaces. This filter is thus continuous in its action. Each machine has a capacity of 25 tons of dry slime per day. It requires very little power and labor to operate. One man can attend 15 or 20 filters having a capacity up to 800 or 900 tons per shift. Several modifications of the Ridgway filter are now on the market. A modification made by W. A. Caldecott is in very successful operation at the Simmer Deep mine at Johannesburg, South Africa.

The Imlay Process.

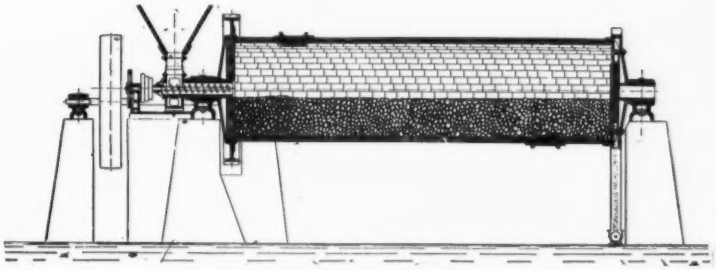
An important improvement in cyaniding has lately been patented by W. L. Imlay, of Philadelphia, Pa. In the Imlay process the sands are crushed to pass a 150-mesh screen and carried to a launder which feeds the top of an inclined lixiviating trough. The trough is from 150 to 200 feet in length and contains a number of rolls and iron plates. When the pulp is fed at the top of the trough it falls by gravitation, and passes through the rolls and over the iron plates. There are about 50 plates and the same number of rolls. Each alternate plate is heated by steam. The rolls are revolved by sprocket wheel flanges and driving chain. The rolls not only agitate the pulp as it passes through them, but develop numerous bubbles in the cyanide solution which contain air with sufficient oxygen to re-supply continuously the excess of oxygen required to keep the cyanide in its most active condition.



TUBE MILLS IN THE STAMP BATTERY OF THE GOLDFIELD CONSOLIDATED MILL.
The Allis Chalmers Co.

The heating of the alternate iron plates is an important feature of this process. Every other plate has a water back on the under side so that steam can be admitted to heat a section across the width of the plate. The admission of steam is controlled by a valve. The steam enters on one side and discharges on the opposite side, and can be regulated to suit requirements.

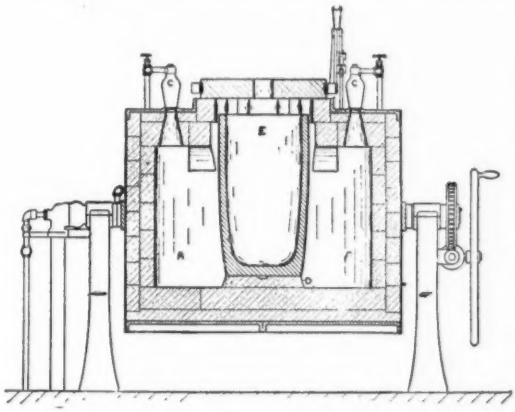
By the time the cyanide and pulp have passed down the 150 feet of the lixivator trough all the values have been dissolved in the cyanide solution. The solution and the pulp leave the lixivator at the lower end and enter a distributing launder (6). This launder can be tilted so as to deliver into either one of two or more sand tanks (7). The cyanide and pulp flow from the lixivator to the launder, then to a sand tank where all the sand settles. As much more solution is used than there is sand, this tank soon overflows through a pipe (9) into a slime tank (8). Both of these tanks are built on the lateral filtering plan, the slime tank (8) having a filtering capacity equal to the discharge over the lixivator. From the time the cyanide solution starts at the top of the lixivator and dissolves the values out of the ore, is filtered, and the values are deposited in the zinc box, and the pump (12) has returned the solution to the stock tank barely 10 minutes elapse.



THE DAVIDSEN TUBE MILL.
F. L. Smidth & Co.

This being a one-solution process but little water is required. Storage tanks for water, weak, medium, and strong solutions, and wash water are not needed. A standard strength of solution, and full quantity in stock tank is all that is employed.

The sand tanks are emptied by any of the usual methods.



TILTING CRUCIBLE FURNACE FOR MELTING CYANIDE PRECIPITATES.

A, combustion chamber; C, burners; E, crucible.
W. S. Rockwell Co.

CONCLUSION.

From this rapid review of modern cyaniding practice it will be noticed that recent improvements have been chiefly of a mechanical nature and made with the object of making the process as continuous and automatic as possible. Fine crushing, vacuum filtration, and the numerous automatic appliances for handling the sand, pulp and solutions during the course of treatment have succeeded in greatly reducing the time and cost of treatment. New processes now in the early stages of development, like the Imlay process just described, promise still better economies in the near future.

THE DISTRIBUTION OF FOUNDRY TONNAGE BURDENS.

By Victor R. Claydon.

THERE apparently is a diversity of opinion as to the correct method of distributing the foundry tonnage burden in a business where the costs are based on the different classes of castings produced; and the purpose of this article to deal with the two main opinions that have been expressed in the course of inquiry on the subject:

1.—That the whole of the tonnage burden should be distributed on the basis of good castings *only* of each class produced.

2.—That the whole of the tonnage burden should be distributed on the basis of good and bad castings of each class produced.

For the purposes of illustration we will assume that we are in a business where the costs are divided into three distinct classes of manufacture, viz: boilers, steam fittings, and jobbing, and that the following are the production reports sent in to the cost office for a fortnight's cast:

(A) Apportionment of Total Melt.

Good Castings produced, all classes	443,585	pounds
Bad Castings produced, all classes	56,260	"
Sprues and Gates	194,595	"
Shrinkage	27,080	"
Total Melt	721,520	"

(B) Distribution of Good Castings.

Boilers	370,951	pounds
Steam Fittings	45,182	"
Jobbing	27,452	"
Total Good Castings	443,585	"

(C) Distribution of Bad Castings.

Boilers	44,294	pounds
Steam Fittings	7,550	"
Jobbing	4,416	"
Total Good and Bad Castings	56,260	"

The tonnage burden on the cast is $1,416.09. We will now divide our costs on the basis of good castings only, of each class produced:

(D) DISTRIBUTION OF TONNAGE BURDEN ON GOOD CASTINGS ONLY.

Class	Pounds	Per cent. of Total Good Castings	Distribution of Tonnage Burden
Boilers	370,951	83.63	$ 1,184.28
Steam Fittings	45,182	10.18	144.16
Jobbing	27,452	6.19	87.65
Total Good Castings	443,585		$ 1,416.09

By dividing our costs on the basis of good and bad castings produced, we get the following results:

(E) DISTRIBUTION OF TONNAGE BURDEN ON GOOD AND BAD CASTINGS.

Class (Add B & C)	Pounds	Per cent. of Total Good & Bad Castings	Distribution of Tonnage Burden
Boilers	415,245	83.07	$ 1,176.35
Steam Fittings	52,732	10.54	$ 149.25
Jobbing	31,868	6.39	$ 90.49
Total Good and Bad Castings	499,845		$ 1,416.09

It is of course, self-evident, that to obtain the cost of the tonnage burden per pound of good castings of any class, we must divide by the good castings *only* of that class, *after* the correct distribution of the costs has been made. The whole purpose of this paper is to try and determine whether table D or E is the correct method of distribution.

Assuming that the distribution according to table D is correct, then it appears to me that the branch of the business which is actually losing the most work, is producing the cheapest castings; which on the face of it seems absurd.

In table E we have the foundry tonnage charge spread over the different classes of castings produced, on a basis of good and bad castings. Although, in the examples given, the percentages do not differ very materially, yet I think they will serve to bring out the point that in distributing the burden on this basis the onus is put on the branch of the business which is losing the most work, and this would seem to be the correct apportionment.

It has been pointed out to me in course of correspondence on this subject, that one cannot consider bad castings as "output." Whilst admitting this fact, it is surely no less a fact that the production of a

certain proportion of them is inevitable in the production of output, and consequently it seems only logical that each class should be burdened with its own proportion of this unmarketable product.

There is just one other point I would like to touch on: In some foundries the item of cleaning and chipping has to be taken as a tonnage burden. In such a case I venture to think that this portion of the tonnage burden should be distributed on good castings only, and for the following reasons: Most of the defective work, in all probability, would be detected before reaching the cleaning shop, and if such is the case, and only an insignificant fraction of bad castings finds its way into this shop, then I suggest this is the correct method. In short, any given element of the tonnage burden should be distributed *only* over the tonnage actually receiving the expenditure corresponding to that element.

The writer will be pleased to hear from others on this subject, and to answer any inquiries that may be made.

Mr. Claydon's contribution is the outgrowth of correspondence that developed so much interest as to merit a wider circulation. For this reason Mr. Claydon was invited to put the problem in concrete form for submission to our readers, and we shall be glad to receive and submit to the author any comment or argument our readers may be disposed to make.—THE EDITORS.

EDITORIAL COMMENT

The Tariff.

ECONOMICS lies next to religion and art among the provinces in which sectarian warfare is eternal and fierce—sometimes because nothing can be proved, and emotional vehemence surges up to fill the voids where logical demonstration should be; sometimes because so many conflicting propositions can be proved, and few brains can compass more than a small fraction of this many. A's fraction and B's fraction may appear hopelessly contradictory, and so they fall to blows; and if C, with rare mastery of mind, discovers that both A's philosophy and B's are true within limits, and deal with different, opposing, but co-existing elements (like the opposing forces whose balance holds the planetary systems in order), then C is probably set upon and belabored by both A and B together.

All of which is introductory to the observation that the new United States tariff measure (itself, by the way, a hodge-podge of effects produced by a mob of self-centred and self-absorbed interests) is an economic phenomenon that will be interpreted variously by various minds, according to their individual philosophies, their innate predilections or prejudices, their inherited or adopted political tenets, or the actual or anticipated effect on their own business affairs. It will be regarded by some as benign and by some as sinister, and the truth will not be proved to the country at large except empirically, by the workings of the Aldrich schedules during the next few years. It may not stand clearly revealed to all even then. The majority, perhaps, will still be unable to disentangle the results of high protection from the consequences of crop failure, or the effects of industrial conditions in Germany, or the influences of Harriman's health on railway affairs, or the manipulations of Wall Street, or from any or all of a vast complexity of factors whose product is the index of prosperity.

It would be very unfair to assume that pocket interest alone will direct individual judgment, or decide a majority of public opinion as to the economic soundness—the goodness or the badness—of the Payne Bill. It should not be said even that a majority of both House and Senate were influenced more by considerations of special advantage to local interests than by a purpose to secure the best results for the country as a whole. But it was nevertheless by selfishness, playing upon honest belief and natural differences of opinion, that the balance was turned. In spite of the earnest effort of a few leaders, to whom all credit is due, and of a few concessions (or apparent concessions) to the demand for free raw materials and general "downward revision," it must be said that in its sum, the bill is a wholesale delivery of the people into the hands of "the interests;" that manufacturers at large, and hence consumers at large, are sacrificed to a few industrial manipulators who hold a grasp upon Federal legislation; that the demand for conditions that would enable America to satisfy her great and growing need—participation in the manufacturing trade of the world—is almost totally ignored or denied; and that a large proportion of the voters who placed the present party in power will feel that the pledges of its leaders have been broken.

In short, while it is not especially significant that a new tariff should excite disapproval in some quarters, nor even that that disapproval should be earnest and shared by a large number of people, it *is* significant to note the character of

the critics of the Payne bill, and the grounds of their criticism.

That the outcome may be a temporary and partly artificial inflation of prosperity is probable; that any such measure can establish the best conditions for permanent welfare and sound expansion seems impossible. Time will tell.

The Highway to Prosperity.

ANY settlement of unsettled conditions leads to some sort of balance, whether permanent or not, and it is certain that the completion of the bill which Congress was called in special session to enact will have a stimulative effect on industry and prosperity, almost irrespective (for the present) of its ultimate tendencies. The long-restrained energy and the capital (which, however apparently dormant, never really sleeps, but watches always and only for confident security of return to start out on new and larger ventures) these two constructive forces are already restless for resumption of work suspended two years ago, and for fresh undertakings. The great underlying industries—steel and transportation—have for some months been preparing for the rush; but their activity of preparation is a fraction only of the activity of performance into which they will be plunged as the already rising tide reaches the constructive and productive industries at large.

The world's consumption of manufactured materials (using the term in its broadest possible sense) as indexed by the primary material of manufacture—iron—increases at a rapid rate of acceleration; and when this rate is temporarily retarded, as it has been for two years past, the speed seems immediately thereafter to be raised above normal, as if material civilization were determined to make up for lost time and regain the place it should have reached by the card. In fact, it often, if not usually, overshoots the mark and runs ahead of the schedule. Upon such a period the United States is now entered. To manufacturers who have used the interval of quietness to set their works in order, to effect improvements in organization, in equipment, and in efficiency, for which opportunity was given—perhaps opportunity long sought but long denied in the foregoing years of overpressure upon forces and facilities—the situation affords a rich certainty. The harvest is waiting to be gathered, and the only solicitude need be for each to secure his full and proper share.

Minor Executives.

ONE of the problems now presented to industrial managers with increasing frequency and insistence is that of the minor executive—the lieutenant whose duties and responsibilities, under modern conditions and in large modern plants, may easily be much larger than those imposed upon many an independent owner or chief in old-time concerns.

The successful filling of such a position requires a rather peculiar combination of talent, experience, and temperament, which to many managers seems obtainable only through selection from a shop-trained force. To others, the more promising course appears to be special education, in the works, of an advanced class of technical graduates, starting upon the foundation of a regular engineering course. That this latter policy has not won wider favor is perhaps due in large part to the long (and only lately and partially corrected) neglect of the technical schools to provide adequate special training for engineering students destined to enter manufacturing plants in professional capacities. As it stands, no thoroughly satisfactory general solution of the puzzle has been advanced. In a future issue of THE ENGINEERING MAGAZINE we shall present an interesting discussion of the points involved, by Mr. H. Keith Trask, an author eminently fitted by experience and observation to discern and weigh the several factors in the problem.

REVIEW OF
THE ENGINEERING PRESS.
"THE WORLD IS ITS FIELD"

RAILWAY DEVELOPMENT IN CHINA.

A BRIEF SUMMARY OF EXISTING LINES AND OF PROSPECTS FOR FURTHER EXPANSION.

Arthur John Barry—Royal Society of Arts.

INTEREST in Chinese railway development and Chinese finance has lately been stimulated in the United States by the action of the State Department in supporting the demand of a group of American financiers for participation in an impending Chinese loan for the extension of the railway system. The trials of foreigners in financial dealings with the Chinese are well described in a long and interesting paper on railway development in China read by Arthur John Barry before the Royal Society of Arts and published in the *Journal* for May 21. This phase of the subject we have not space to touch upon; we give a brief summary of existing lines and Mr. Barry's opinion of the prospects for further expansion.

The history of railway development in China divides itself naturally into four periods. "The first period was marked by the attempt of the foreigners to induce the Chinese to permit them to introduce railways into the country, an attempt which failed before the fanatical and strenuous opposition of the governing classes. In the second period we find an influential though comparatively small number of Chinese themselves borrowing the ideas of the foreigner, and succeeding, in face of much opposition, in bringing about the construction of the first railway in China. During the third period, the Chinese having become more or less accustomed to railways, grasp the fact that they are necessary to the welfare of the country, and consent to the admission of capital for railway construction on mutually advantageous terms. The fourth and present stage is characterized by a growing intolerance of foreign guidance and assistance, other than purely financial."

The first attempt to introduce railways into China was made by Sir Macdonald Stephenson over 45 years ago. He drew up a comprehensive scheme for railway construction which was politely received by the Chinese Government and as politely pigeonholed. It was not until 1875 that railway construction of any kind was attempted in the country. In that year a narrow-gauge railway 12 miles long was laid on an ordinary road between Shanghai and Woosung. The operation of this line promised to be entirely successful. It was enthusiastically patronized by the Chinese, but after a short period of operation the Government seized upon a flimsy pretext to condemn and close the line. It was purchased by the Government at cost price and the rails, rolling stock, etc., were shipped out of the country. With the destruction of this road ends the first stage of railway development in China.

The second stage is marked by the inception by Tong Kin Sing of what is now the most important railway system of China, the Imperial Railway of North China, about 600 miles long, connecting Pekin and Mukden. It had its beginning in a small railway seven miles long,

designed to convey coal from Tong Kin Sing's mines at Tongshan to the head of a small canal. In the face of much opposition, which the support of Li Hung Chang did much to overcome, the line was gradually extended to Tongku, Tientsin, Pekin, the Great Wall, and finally to Mukden. The capital was raised principally in England. In 1908 the excess of receipts over expenses amounted to about £1,000,000.

The close of the war between China and Japan marked the close of the second period of railway development and the commencement of the third. The Chinese Government realized that the disastrous result of the war was due in large measure to lack of transportation facilities and all official opposition to railway expansion ceased. About this time Russia, France and Germany each had in view a definite programme of railway development in China, the objects of which were partly commercial but principally political. In due time the various political aspirations of these three powers took concrete form, and as a result the following railways came into being:

First, the Russian railway, called the Eastern Chinese Railway, from Manchoarie on the Siberian Railway through Tsitsihar and Harbin to Vladivostock, with a branch from Harbin to Yingkow, Port Arthur and Talienwan. This line is to revert to the Chinese Government in 80 years and may be repurchased at the end of 36 years.

Second, in the south, the French projected railway from Lao kai to Yunnan which it is expected will be completed next year. The total length of the line is 280 miles; 80 years after the date of completion the railway is to revert to China.

Third, the German railway in Shantung between Kiao chau and Chinan Fu. About 240 miles of the German system was opened in 1904.

To these political railways must now be added the South Manchurian Railway which is owned by Japan. The status of these railways is entirely different from that of subsequent lines. They are concessions in the true sense of the word and are to all intents and purposes the property of the countries named. In the case of the remaining railways the sovereign rights of China are not impaired. The loan agreements between the Government and the various syndicates are all practically similar in principle. The Chinese Government borrows money at 5 per cent. interest, and gives the syndicates certain facilities and privileges which enable them to make sure that the money is economically and honestly expended. The loans are secured in the first instance by a mortgage on the railway itself; a small share of surplus profits is granted the syndicates in addition to the guaranteed interest. The profits of the syndicates are represented by any difference between the issue price and the price which the Chinese Government agrees to take for each £100 bond. The syndicates usually act as agents for the supply of material, on which they are permitted to charge a commission on the cost.

The list of railways which belong to the third period and for which the capital was raised on the general principles outlined above is as follows:

1. Pekin-Hankow. Length, 760 miles. Financed by a Belgian syndicate which underbid a group of American finaciers with whom negotiations were first opened. Earns large profits.
2. Hankow-Canton. May be regarded as a continuation of the Pekin-Hankow. American, Belgian, German and British syndicates have been interested in its fiinancing. The line is not completed. Financial difficulties have only recently been removed.
3. Pekin Syndicate Railway. A coal road 90 miles long. Has been bought by the Government.
4. Chenting-Fu-Taiyan-Fu. 160 miles long. Acquired by a French syndicate from the Russo-Chinese Bank.
5. Kaifeng-Fu-Hsian-Fu. Under construction by a Belgian syndicate. 140 miles long.
6. Pinghsiang-Chuchow. Capital raised in China. A coal road 60 miles long.
7. Swatow-Chao Chau-Fu. A private line 30 miles long built by Japanese engineers.
8. Macao-Canton. Under construction by a company, half of whom are Portuguese and half Chinese. 130 miles long.
9. Pekin-Kalgan. 125 miles long. Being built by the Chinese out of the profits of the Imperial Railways of North China.
10. Shanghai-Nanking. Built with British capital. Opened in 1908. About 200 miles long.

To the fourth period of railway development belong four railways, the financing of which has been increasingly more difficult, owing to the attitude of the Chinese Government.

1. Canton-Kowloon. A very important line, 100 miles long. Built with British capital. Not yet completed.
2. Tientsin-Pukow. Partly British and partly German. Now under construction. The whole line is 636 miles long.
3. Soochow-Hangchow-Ningpo. Being built with British capital but by Chinese officials and engineers.
4. Pookow-Sinyang. Only preliminary negotiations for the financing of this line in London have been made.

"China is fully alive to the advantages of railways, and is now as anxious to build them as at first she was opposed to their construction. That the Chinese railway system is in its infancy goes

without saying. The railway system of India, for example, is only partially developed, but with a population of about 240,000,000 India can at least boast of about 30,000 miles of railway, whilst China, with a population greater by, perhaps, nearly 100,000,000, can at present show about 5,000 miles of railway only. Before Chinese railway development can compare with that of India another 30,000 miles or so will have to be built at a cost of, say, over £200,000,000 sterling.

"Whether railways should be constructed by private enterprise in China, or whether the principle of state ownership should be universally adopted, is, perhaps, a matter of opinion. On this matter I think that state ownership is not only best for China but the only possible system compatible with success. Not only has experience so far demonstrated that Chinese railway companies are a mistake, but it would also be impossible to raise any large amount of capital by means of private companies in China. Private companies, too, would not have behind them the necessary power and authority which only the government itself possesses. In private companies in China there would be too many private interests to be considered antagonistic to the interests of the undertaking and the Chinese public. For these and many other reasons I think that the Chinese Government would do well to keep the construction of the railway system of the country in its own hands.

"If the state is to take charge of the future development of the railway system of the Empire, the question arises as to how they can raise the capital required. Can they raise it at home, and if not, can they raise it abroad? There are many reasons why I think they cannot raise money in China. The question of raising capital abroad is one which could better be answered by a financier than by me, but I cannot help thinking she can on reasonable conditions. It is true that the general financial position of China is being adversely criticised lately. I saw for example an article in the *Globe* on March 4, in which it was stated that the foreign debt of China was £125,000,000 sterling, and that when the interest on this had been paid there only remained about £6,000,000 with which to meet the executive expenses of the Empire. If these figures are correct it is clear that China will have to find some new source of revenue before she can borrow much more money for railways. The railways themselves could be made to present the necessary source of revenue. I venture to believe that railways in China can be made to pay perhaps better than anywhere else in the world, but if railways are to be made to pay, first, all the money borrowed for them must be spent on the purpose for which it is borrowed and with due regard to economy and efficiency.

"At present there are very few Chinese qualified railway officers. There are a certain number of able Chinese engineers no doubt, but for many years to come there will not be enough qualified men to go around. In an engineer experience is even more important than theory, and reliable engineers take years to train. There is little doubt, therefore, that for some time to come China will have to engage engineers from abroad to meet her requirements, and the same remarks apply to the senior officers of other railway departments. There is nothing derogatory to Chinese dignity in this. China has always been loyally served by the foreigners whom she has employed, and always will be. Their knowledge and experience in their own spheres have been, and will be, of the greatest benefit to her in every way; but if China is to be able to borrow the money she requires abroad, on the best terms, it will be necessary to cultivate the confidence of the foreign investor, a confidence which recent events have been calculated to shake.

"What I venture to think is required is a strong and capable railway department or Board in Pekin, so constituted as to command the confidence of the foreign investor, and strong enough to command respect everywhere in China itself. The present Board of Communications falls short of this. Such a department would have its staff of expert assistants and inspectors, both Chinese and foreign, and would keep in touch with the admin-

istration of each railway, who would be responsible to the Board. The net earnings of all railways after payment of the cost of maintenance and renewals would be paid to the Government Railway Department—the principles of its organization might be somewhat similar to those of the Imperial Maritime Customs. A definite policy and a definite programme of railway construction should be laid down. To build up the revenues of the Board the best paying railways should be constructed first. The revenues and expenditures of the Board should be published. In time I think a Board so constituted would be able to raise loans on its general revenues and pay off the various loans for the service of which the revenues of different existing railways are now hypothecated. To begin with, the Board ought to be able to show as revenue the surplus earnings of the Imperial Railway of North China and of the Pekin-Hankow line, which (from information from Chinese sources so far as the latter railway is concerned) amount when taken together to about £800,000."

PROFIT-SHARING IN COAL MINING

THE CONDITIONS OF PARTICIPATION IN THE EXPERIMENT AT THE WINGATE COLLIERY.

Sir Christopher Furness—Iron and Coal Trades Review.

THE recent acquisition of the Wingate Colliery has given Sir Christopher Furness an opportunity to extend to the coal-mining industry the principles of profit sharing which have been for several years in successful operation in his ship-building works. The Wingate Colliery produces annually about 350,000 tons and employs about 1,400 men and boys. The purchase price was £175,000. The whole of the property has been vested in a company with a capital of £200,000 in £1 shares, not less than three-quarters of which are to be held by Sir Christopher and two associates. The remainder are to be divided up among all the officials and men employed by the company. The conditions attaching to participation in the co-partnership on the part of the colliery workers, as communicated in a recent address by Sir Christopher to his workmen, published in the *Iron and Coal Trades Review* for May 28, are these:

"1. While the Board of Directors will retain for the officials of the company the full power to employ men as the circumstances of the moment may determine, the general conditions of working and payment accepted by the Miners' Union will be duly recognized. On the other hand, it is well that it should be understood from the beginning that, in view of the advantages in which employees engaged on the colliery will certainly share, as well as other benefits that may possibly accrue to them, our officials will be under strict injunctions to see that only men of capacity and industry, discreet conduct and sober habits, and regularity in hours shall be retained in the service of the company.

"2. Every employee, whatever his status—for according to my standards, laborers have rights equally with other members of the working-class community—every employee, I say, becomes a member of the co-partnery by signifying assent to its principles, and by acquiescing in the regular deduction of 5 per cent from his pay until the shares to be allotted to him, and which he must apply for, are fully paid, thus enabling him to acquire his holding by gradual instalments; and no employee can continue in the service of the company for more than three months unless he becomes a co-partner.

"3. The laborer co-partners—who in other respects will be as the workmen of other collieries in the county of Durham, not forgetting the legal rights conferred on employees by the Workmen's Compensation Act—will participate to the extent of their share holdings in such profit as may from time to time be paid in dividends by the company. Large and small shareholders alike will be placed on precisely the same footing.

"4. The control of the company's affairs will be vested in the Board of Directors, and no one but the management

will possess authority to discharge as well as to engage workmen, with responsibility to the board alone. Alongside this form of administration, however, there will exist a colliery council, composed equally of representatives of the directors and representatives of the employees, which body shall become the repository of information of importance or interest that may be communicated without injury to the company's welfare, shall have power to investigate and bring efforts of conciliation and persuasion to bear upon matters that may come into controversy between employees and employers or their representatives, and shall be entitled, by majority vote, to make representations and offer counsel to the board in matters directly relating to the working arrangements and conditions associated with the colliery. Furthermore, the representatives of the employees would possess the privilege of summoning to meetings of the council, whenever their advice was desired, the officials of their trades unions, who would be entitled to elicit information and to address the council on the subject occupying its attention. But these are points of detail which can be settled in conference subsequently, should you and your fellows resolve to co-operate in the execution of the scheme now propounded.

"5. The above outlined arrangement, alike in its parts and in its entirety, is subject to the cardinal and supreme condition that in acquiescing in it the co-partners, while accepting the hours, wages and other conditions of labor actually secured generally by the employees' trade unions throughout the county, which shall govern this compact, agree to substitute, on the one part for that barbaric instrument the strike, and on the other part for the equally out-of-date instrument the lock-out, conciliation by the Colliery Council, or, this failing, arbitration by a court of representatives of employers and employees, and presided over by the County Court Judge of the district or his nominee, the chairman of such court to be regarded as final arbiter in all matters of dispute.

"The single sacrifice you would make in return for all these advantages would be the sacrifice of the power to go on strike whenever a bit of temper seized you—for, mark you well, a strike, however limited in its character, would instantly bring the co-partnery to an end, at any rate so far as concerned the strikers, who would cease all connection at any time with the colliery, the term partnership carrying with it a responsibility for justice to the interests of other partners which cannot be ignored."

AMERICAN CYANIDE PRACTICE.

A SUMMARY OF EQUIPMENT AND PRACTICE IN NINETEEN OF THE LARGEST MILLS IN THE UNITED STATES AND MEXICO.

S. F. Shaw—American Institute of Mining Engineers.

ON another page of this issue, Mr. Arthur Selwyn-Brown gives a general review of modern cyaniding practice and machinery, with special reference to the many important improvements introduced within the last few years. As a supplement to Mr. Brown's discussion we present a number of tables, taken from a paper to be read by S. F. Shaw at the forthcoming Spokane meeting of the American Institute of Mining Engineers, which give a summary of the principal details of cyanide practice in nineteen of the largest and most modern mills in the United States and Mexico.

The mills chosen by Mr. Shaw are:

1. A Colorado mill, the name of which he is not permitted to give.
2. Combination, Goldfield, Nev.
3. Desert, Millers, Nev.
4. Dos Estrellas, El Oro, Mexico.
5. El Oro, El Oro, Mexico.
6. El Rayo, Santa Barbara, Chihuahua, Mex.
7. Goldfield Consolidated, Goldfield, Nev.
8. Guanajuato Consolidated, Guanajuato, Mexico.
9. Guanajuato Development Co. (Pinguico Mill) Guanajuato, Mexico.
10. Guanajuato Reduction and Mines Co., Guanajuato, Mexico.
11. Homestake, Lead, S. D.
12. Loreto (Cia Real del Monte y Pachuca), Pachuca, Mexico.
13. Montana-Tonopah, Tonopah, Nev.
14. North Star, Grass Valley, Cal.
15. Palmarejo, Chihuahua, Mexico.
16. San Prospero, Guanajuato, Mexico.
17. San Francisco, Pachuca, Mexico.
18. Standard, Bodie, Cal.
19. Veta Colorado, Parral, Chihuahua, Mex.

The tables following give the details of the stamp mill equipment, tube mills, tables and vanners, collecting and settling tanks, leaching tanks, agitation tanks and filter presses, and a summary of the consumption of materials per ton of ore treated. Mr. Shaw's paper contains, of course, in addition to the tabular data here presented, a vast amount of information regarding minor points of practice at the various mills which we have not space to reproduce. In conclusion, however, he gives some details of extraction and costs which we may summarize briefly.

At the Colorado mill mentioned above the extraction is 94 per cent. At the Combination mill the total extraction is 94.8 per cent, divided as follows: plates, 42.5 per cent; concentrates, 22.3 per cent; leaching, 14 per cent, and slimes, 16 per cent. The total costs (given in detail by Mr. Shaw) are $4.04 per ton. Detailed costs are given for the Desert and Dos Estrellas mills, the totals being, respectively, $3,367 and $1,350 per ton. At the Guanajuato Consolidated, the crushing and concentrating costs are $0.55, and the cyaniding costs, $1,615 per ton, a total of $2,165. The total milling and cyaniding costs for this mill for the whole year 1908 are given as $2.30 per ton. The cost of cyaniding slimes at the Homestake is given as $0.2453. At the Guanajuato Reduction, the gold extraction is 88 per cent, and the silver extraction 86 per cent, the cost being $1,575 per ton. At the Montana Tonopah the total cost of treatment is approximately $3.50 per ton; the gold extraction is 94 per cent, and the silver extraction 87 per cent. The costs for crushing, concentrating and cyaniding at the North Star are $0.85 per ton.

TABLE I. DETAILS OF STAMPS IN MODERN MILLS.

Name of Mill.	No. of Stamps.	Weight of Stamps, Pounds.	Height of Drop, Inches.	Duty Per Drops, Per Min.	Duty Per 24 Hr., Tons.	Screen Mesh.	Life of Die, Days.	Life of Shoe, Days.	Life of Screen, Days.
Colorado	60	1,050	6 to 8	100	3.8	26	50	112	3
Combination	20	1,200	6	108	4.5	....	74	96	10
Desert	100	1,050	6	104	4.79	12-14	59	76	30
Dos Estrellas No. 2	120	1,250	6.5	102	4.2	16 & 26	65	65	2 to 5
El Oro	100	1,000	7.5	104	3.75	35			
	100	1,150	6	102	4.00				
Goldfield Consolidated	100	1,050	....	108	....	16			
Guanajuato Consolidated.	80	1,050	7.5	104	3.6	50	....	....	30-35
Guanajuato Development (Piuguico)	40	1,050	6.5	104	6.25	2, 4 & 8			
Guanajuato Reduction	160	1,050	7.5	100	3.1	26			
Homestake	1,000	900	10.5	88	4.0	No. 8 slot			
Loreto	40	1,050	....	106	3.0	16			
Montana-Tonopah	40	1,050	7	100	3.5	20			
North Star	80	1,050	8	96	3.1	20	....	....	25
San Francisco	30	1,050	6.5	104	....	20			
Standard	20	1,000	4 to 6	96-106	2.3	30	57	122	55
Veta Colorado	100	1,050	7	....	....	8-10			

TABLE II. DETAILS OF MODERN TUBE-MILLS.

Name of Mill.	Size. Make.	Number.	Diameter.	Length.	Rev. Per Min.	Capacity Per 24 Hours, Tons.	Power, H. P.	Pebbles. Kind.	Pebbles. Consumption Per Ton Ore, Pounds.	Lining. Kind.	Lining. Consumption, Pounds.
Combination	Abbé	1	4 ft.	16 ft.	26	30	16	Danish	2.4	Silex	1.2
	Abbé	1	4 ft.	12 ft.	26	24	14				
Dos Estrellas	A-C.	5	5 ft.	24 ft.	26	121	55	Quartz	...	El Oro	0.84
El Oro	Abbé	2	4 ft. 6 in.	19 ft. 6 in.	31	100	50	.....	8.4	El Oro	1.0
	Krupp	1	3 ft. 11 in.	19 ft. 6 in.	31	110	48				
	Krupp	1	4 ft. 11 in.	23 ft.	25	190	80				
	Krupp	1	4 ft. 11 in.	26 ft.	27	275	87				
Goldfield Consolidated	Gates	6	5 ft.	22 ft.							
Guanajuato Reduction	Abbé	2	4 ft. 6 in.	20 ft.	..	80	43	Danish	0.75	Silex	
Loreto	Abbé	2									
	Krupp	1									
Montana-Tonopah	Gates	2	5 ft.	22 ft.	27	52	42.5	.....	2.22	Silex	
North Star	Abbé	1	4 ft. 6 in.	20 ft.	20	30	16	Quartz	40	Chl'd Ir	
San Francisco	Krupp	—	4 ft. 3 in.	13 ft. 1 in.	29	...	..	Danish	...	El Oro	
Standard	Gates	1	5 ft.	22 ft.	24	125	50	Danish	3.0	S. Steel	0.5
Veta Colorado	.....	5	5 ft.	14 ft.	..	...	..	.....	...	Ch. Stl	

TABLE III. DETAILS OF TABLES AND VANNERS.

Name of Mill.	Tables.	Vanners.	Concentration Ratio.	Recovery, P. C. Silver.	Gold.
Colorado	11	30	13-18 to 1		
Combination	....	7	40 to 1	22.3	
Desert	25	9	90 to 1	15.63	30.32
El Rayo	....	16			
Goldfield Consolidated	70				
Guanajuato Consolidated	16	13	50 to 1	50	
Guanajuato Reduction	32	18	.....	31.0	28.0
Loreto	8	30			
Montana-Tonopah	8	16			
North Star	9				
San Francisco	6				
Veta Colorado	24				
San Prospero	8	....	230 to 1	24	

TABLE IV. DETAILS OF COLLECTING- AND SETTLING-TANKS.

Name of Mill.	Number.	Size, Feet.	Total Capacity, Cu. Ft.	Capacity Per 24 Hr., Cu. Ft. Per Ton.
Sands.				
Colorado	3 4 1	40 by 6 23 by 6 30 by 8	38,247	165
Desert	4	33 by 7.5	25,659	80
Dos Estrellas	8	22 by 7	21,288	110
Guanajuato Reduction	3	40 by 8	36,159	139
North Star	6	14 by 10	8,640	170
Palmarejo	1	100 by 80	32,000	
Slimes, settling.				
Combination	4 2	12 by 6 16 by 9	6,333	97
Desert	4	36 by 20	81,430	480
Dos Estrellas	cone	34 by 35	10,592	28
El Oro	4	36 by 20	81,430	215
Goldfield Consolidated	16	29.5 by 12	131,230	230
Guanajuato Consolidated	24 3	9 by 9 by 8 8 by 8 by 30	18,432	125
Guanajuato Development	5	30 by 11.5	40,644	225
Guanajuato Reduction	3	18 by 22	16,797	70
Homestake	9 9	18 by 20 26 by 20	141,372	90
Montana-Tonopah	3	30 by 10	21,206	150

TABLE V. DETAILS OF LEACHING-TANKS.

Name of Mill.	Number of Tanks.	Size of Tanks, Feet.	Total Capacity, Cubic Feet.	Capacity Per 24 Hr., Tons.	Time of Treatment, Hours.
Colorado	3 4 1	40 by 6 23 by 6 30 by 8	38,247	165	
Combination	16	16 by 5	16,085	180	288
Desert	18	33 by 8	123,161	335	305
Dos Estrellas	12	36 by 5.5	67,176	385	184
El Oro	12	40 by 6.5	98,018	165	369
El Rayo	...	25 by 6	.....	....	210
Guanajuato Consolidated	7[a] 15	26 by 5 26 by 6	66,367	490	336
Guanajuato Development	14	29.5 by 5	47,845	190	
Guanajuato Reduction	15	40 by 8	150,795	580	480
Homestake	14	44 by 9	191,587	80	120
North Star	6	23 by 8	17,500	290	168

a Used for collecting-tanks also.

TABLE VI. DETAILS OF AGITATION-TANKS.

Name of Mill.	No. of Tanks.	Size, Ft.	Total Capacity, Cu. Ft.	Capacity Per Ton Slime, Cu. Ft.	Time of Agitation, Hours.
Combination	1 2	12 by 18 10 by 14	4,234	65	16
Desert	7	36 by 20	142,500	838	30
Dos Estrellas	12 6	36 by 10 36 by 20	243,296	750	13.6
El Oro	15	34 by 12	163,440	270	56
El Rayo	.....	25 by 16	.....	.....	24
Goldfield Consolidated	10	15 by 45	62,500	110	
Guanajuato Consolidated	14	30 by 10	98,960	660	300
Guanajuato Reduction	13	36 by 12	158,789	660	72
Loreto	27	30 by 10	190,852	1,270	54
Montana-Tonopah	6	17 by —	.....	.....	32
North Star	2	8 by 7	1,500	30	
San Francisco	5	15 by 45	31,250	.....	24
Standard	5 5	20 by 11 18 by 15	36,264	290	18
Veta Colorado	14	15 by 45	87,500	175 (est.)	

TABLE VII. DETAILS OF FILTER-PRESSES.

Name of Mill.	Make of Press.	No.	Size of Leaf, Ft.	Total Area, Sq. Ft.	Area Per Ton, Sq. Ft.	Time of Cycle, Hours.
Combination	Butters	54	5 by 10	4,708	72	227
Desert	Butters	172	4.3 by 9.75	14,448	84	180
Dos Estrellas	Burt	70	28.3 sq. ft.	1,984	...	37
El Rayo	Butters	60	5 by 10	5,100	146	240
Goldfield Consolidated	Butters	336	5 by 10	28,560	50	(est.)
Guanajuato Development	Butters	80	5 by 10	6,800	97	180
Guanajuato Reduction	Butters	75	5 by 10	6,375	40	90
Homestake	Merrill	2208	4 by 6	52,992	32	600
Liberty Bell	Moore	268	6 by 8	21,869	62	135
Loreto	Butters	104	5 by 10	8,840	74	120
Montana-Tonopah	Butters	144	5 by 10	12,240	85	
North Star	Oliver	....	10 by 7 ft. revolving drum.	220	4.4	5.5
San Francisco	Butters	....	.....	.....	...	180
Standard	Moore	90	5 by 16	12,240	111	360
Veta Colorado	Ridgway	130	4 sq. ft.	520	1	(est.)

TABLE VIII. CONSUMPTION OF MATERIALS PER TON OF ORE TREATED.

Name of Mill.	Die, Lb.	Shoe, Lb.	Tube-Mill. Pebbles, Lb.	Tube-Mill. Lining, Lb.	KCN, Lb.	Zn, Lb.	CaO, Lb.	Pb.$(C_2H_3O_2)_2$, Lb.
Colorado	....	....	....	....	0.93	0.53	2.1	0.005
Combination	....	....	2.4	1.2	2.10	0.98	8.0	0.5
Desert	0.53	4.8	....	....	3.41	1.82	14.92	0.62
Dos Estrellas	....	....	....	....	1.17[a]	1.07	9.78	0.13
El Oro (sand)	....	....	8.4	1.0	2.8	1.2	12.0	
El Oro (slime)	....	....	....	....	0.75			
El Rayo	....	....	....	....	5.0	1.2	16.0	
Guanajuato Consolidated	....	....	....	....	5.15	1.3	6.0	
Guanajuato Reduction	....	....	....	....	1.70[a]			
Homestake (slime)	....	....	....	....	0.31	0.13	4.5	
Loreto	....	....	....	....	2.2[a]	....	8.8	
Montana-Tonopah	....	....	2.22	....	2.8	0.97	9.2	0.28
North Star	....	....	40.0	....	0.5	0.33	4.0	
Standard	1.16	0.63	3.0	0.5	1.16[a]	0.6	7.5	

[a] NaCN.

THE ECONOMY OF MARINE PRODUCER-GAS POWER.

A REPORT OF REMARKABLE FUEL ECONOMY IN A TRIAL RUN OF THE MOTOR BOAT "MARENGING."

International Marine Engineering.

A SMALL motor boat built during the past year for Mr. H. L. Aldrich, publisher of *International Marine Engineering*, has recently given a conclusive demonstration of the feasibility of using producer-gas power in vessels of small size. Mr. Aldrich has been for years a firm believer in the applicability of the gas producer and engine to marine power plants of from 25 to 500 horse power; the *Marenging* was built with the special purpose of investigating whether, within the limits of space and weight available in an ordinary commercial marine power plant, an economical and satisfactory producer and engine unit, using ordinary coal as fuel, could be installed. The results of a trial run of nearly 300 miles, which show a remarkable fuel economy for a 35 horse power plant, are published in *International Marine Engineering* for August.

"The boat is 40 feet long over all, with a beam of 9 feet, and a mean draft of 3 feet 6 inches, and is driven by a four-cylinder, four-cycle engine, with cylinders 5¼ inches in diameter by 6 inches stroke, which turns from 400 to 500 revolutions per minute. The engine is fitted with a reversing gear, mounted in an extension of the main bed, and drives a solid three-bladed bronze propeller 24 inches in diameter.

"The engine used on this boat is a regular stock motor, designed for using gasoline, the only changes made for producer gas being in the nature of considerably higher compression than is ordinarily met in gasoline engines. The

inlet and exhaust valves and piping on this engine were exceptionally large, so that no changes were necessary on these parts. For the most successful operation on producer gas, the compression in the engine should be about 150 pounds per square inch. With this particular engine it was impossible to get much over 100 pounds, and, therefore, the results were not as good as could be expected with an engine especially designed for the service.

"No attempt has been made to carry out tests involving extreme refinement because the inadequacy of the engine would make such tests of little value. What has been shown, however, is the fact that marine producer-gas plants can be successfully operated with remarkable economy. This has been well demonstrated to the satisfaction of the owner and many marine engineers and naval architects who have seen the plant in operation. Compared with a steam-power plant, this boat has shown remarkable economy, averaging a horsepower an hour on slightly over a pound of coal. In regular service the boat covers between 800 and 900 miles on a ton of anthracite pea coal, costing (depending upon where the coal is purchased) between $3.50 (14 shillings) and $5.00 (21 shillings). This amount of coal covers the banking of fires and starting up at frequent intervals. If the boat were started out on a continuous run, it is believed that it would make practically a thousand miles an a ton of coal. The average speed of the boat is between 8 and 9 miles an hour.

"Such a non-stop run was attempted on July 9, the boat leaving the Hudson River Yacht Club, at the foot of West Ninety-second street, New York City, at 4.48 p. m., bound up the Hudson River to Albany and return, a distance of 275 miles. Unfortunately, considerable trouble was encountered in navigating the boat in certain parts of the river during the night, as large quantities of eel grass and weeds grow near the sides of the channel, in which the propeller became fouled a number of times, causing unavoidable shut-downs. Two such mishaps on the way to Albany delayed the boat for from ten minutes to an hour each time, and the same difficulty was encountered, to a certain extent, on the return trip, preventing a strictly non-stop run. The results, however, even considering the shutting down and banking of fires, must be considered remarkable.

"The summary of the trip is as follows:

July 9, 4.48 P. M., started from Hudson River Yacht Club dock.
July 10, 3.30 P. M., arrived first bridge at Albany.
July 10, 3.32 P. M., started for New York.
July 11, 10.15 A. M., arrived Hudson River Yacht Club dock.

Total mileage	275
Pounds coal burned to Albany	351
Pounds coal burned to New York	285
Total pounds coal burned for trip	636
Time to Albany	22 hours 42 minutes
Time to New York	18 hours 43 minutes
Time for entire trip	41 hours 25 minutes
Pounds of coal burned per mile to Albany	2.55
Pounds of coal burned per mile to N. Y.	2.07
Pounds of coal burned per mile entire trip	2.31
Pounds of coal burned per hour to Albany	15.45
Pounds of coal burned per hour to N. Y.	15.20
Pounds of coal burned per hour entire trip	15.32

"One of the principal objects in view when this boat was brought out was to demonstrate to the owners of coastwise schooners in the lumber, coal, and other trades, also to the owners of fishing boats, oyster boats, and owners of yachts requiring less than 500 horsepower, the fact that producer gas has many striking advantages over either steam or gasoline. A producer-gas plant can be installed on a fore-and-aft-rigged vessel at small expense, and can be operated at very slight cost. The cost of operation with anthracite coal costing about $4 (16 shillings) per ton, as shown by tests made on the motor boat *Marenging*, is practically one-tenth of what the cost would be if gasoline were used at a cost of 15 cents (7½ pence) per gallon. As a matter of fact, gasoline can seldom be bought at this price, and in many places it costs twice as much, so that the great economy of the producer-gas plant over a plant operated on gasoline is evident.

"As compared with a steam plant, the producer-gas plant, judging from the results obtained with *Marenging*, can show a decided increase in economy over a steam plant, since a horse power an hour can be obtained on slightly over one pound of coal; whereas in the ordinary tugboat using high-pressure steam it is doubtful if a horsepower an hour is obtained on much less than 5 pounds of

coal. On large steamships and warships a steam-power plant shows, of course, better economy than a tugboat, a horse power an hour being obtained on an average of from 1¾ to 2 pounds of coal. A saving of from 25 to 50 per cent in such plants, however, means a large sum of money.

"Another advantage which should recommend this type of installation as an auxiliary in coastwise schooners and the like, is the ease of operation. Any man who can take proper care of an internal-combustion engine can, without any difficulty whatever, manage a producer-gas plant. It requires little, if any, more skill to manage such a plant than it does to manage an ordinary kitchen range."

A TRAIN FERRY SYSTEM BETWEEN GERMANY AND SWEDEN.

A BRIEF DESCRIPTION OF THE NEW RAILWAY TRAIN FERRIES BETWEEN SASSNITZ AND TRELLEBORG.

The Engineer.

THE inauguration on July 7 of a train-ferry service between Sassnitz, Germany, and Trelleborg, Sweden, the joint enterprise of the German and Swedish Governments, marks the beginning of a new era in the development of transit facilities between continental Europe and the Scandinavian peninsula. Direct communication between these two points, which are separated by a 65-mile stretch of the Baltic, has been maintained by a fleet of modern freight and passenger steamers. Within the last ten years the passenger traffic on this line has nearly doubled, but the freight traffic has always been comparatively unimportant and has failed to show a corresponding increase. This has been attributed in great part to the competition of the Gjedser-Warnemünde car-ferry service between Germany and Denmark, which, in connection with two car-ferry routes between Denmark and Sweden, maintains a daily through service between Berlin and Copenhagen. The volume of freight traffic between continental Europe and Sweden and Norway has now reached considerable proportions and the substitution of a train-ferry service for the steamship connection between Sassnitz and Trelleborg has been based on very favorable prospects of attracting to the new line a large amount of through freight business. Two ferry steamers each have been built by the Swedish and Prussian State Railways, two for ordinary traffic and two for reserve. They are designed to make the trip in four hours. While this represents no saving in time over the steamship service, a considerable improvement has already been made in through railway service between Berlin and Stockholm and it is expected that the through service will soon be extended to other points. The following data on the engineering features of the new system are taken from articles in *The Engineer* for July 16 and 30.

"In connection with the establishment of the new service special rolling stock has been introduced, and at the outset 45 new passenger coaches, comprising sleeping, baggage and mail vans, have been provided, of which number 30 have been built at various Swedish works for the Swedish State Railways. These vehicles are of the most modern design, and have cost about £3,000 each. They are all built to suit the loading gauge of the Prussian State Railways, which is somewhat less than that of the Swedish State Railways. The scheme also involved considerable additions and improvements at the harbours at Sassnitz and Trelleborg and the construction of special train-ferry basins and piers at both places, in addition to deepening and dredging operations. At Sassnitz the work is being carried out on behalf of the German Government, and it is intimated that the alterations there will involve an expenditure of £230,000. At Trelleborg the piers are being extended, new lighthouses have been erected, and the inlet deepened to 23 feet, and the width of entrance increases to 167 feet. The cost of the new works at Trelleborg harbour is estimated to be about £120,000

and the scheme is being undertaken by the local authority, with special Government aid.

"All four ferryboats are from the same general outline and have the same length (370 feet) and beam (51 feet) and other overall dimensions, consequently there is practically no difference in the lay-out of the quays and landing stages, and for the purposes of the present notice those at the Trelleborg harbour may be briefly referred to. The appliances used for the transfer of railway trains may be divided into:—(*a*) the landing berth, and (*b*) the connecting link between the land railway line and the ship railway line. The landing berths consist of stone piers, lined with wooden piles, so as exactly to suit the form of the vessel. The wooden pile structure is connected with the stone piers by a series of iron spring buffers. Upon reaching the basin the ship strikes against the wooden piles on one side; these yield, owing to the spring buffers, and ricochet her gently to the piles on the other side, until the vessel is gradually brought to rest, firmly embedded in the structure of the wooden piles. The connecting link between the land railway and the rails on the ship consists of a bridge of steel construction, ordinary open girder work, 160 feet in length, and consisting of two portals, hinged at one end, with another hinge in the middle, so that the outer hinge only is used under ordinary conditions. At the sea side the bridge is provided with a large steel bolt, which fits into a hole in the stern of the ferryboat, and thus rigidly maintains strict alignment between the land rails and ship rails. The time occupied by the electrically-controlled hoist in raising the bridge from its lowest to highest point—18 feet—is about 2½ minutes, and the time occupied in lowering it the same distance is 30 seconds. When no vessels are in the basins the bridges are each maintained at their highest point, so as to be ready for lowering on to the stern of the train-ferry when it arrives. In this portion of the Baltic Sea there is no tide of any importance, but there is a variation in the level of the water at Sassnitz and Trelleborg of about seven feet, on account of the winds. No difficulties have arisen in embarking or disembarking of the railway vehicles, and experience gained has already demonstrated the practicability of transferring eight heavy bogie coaches either from ship to shore or *vice versâ*, within a period of fifteen minutes from the time of arrival of the ferry at the basin or of the train at the landing berth. Pending the completion of the second ferry of the Swedish Government, the service is at present being performed by two of the train-ferries, with the second German vessel held in reserve.

"The steamships which have been specially built for the new joint railway train-ferry service of the German and Swedish Governments, are of outstanding interest, and no other railway car-ferries in Europe or America are comparable to them in point of size, speed, accommodation and the provision of safety precautions. The *Drottning Victoria*, which was recently built in England, for the Swedish Government may be taken as typical of the ferry fleet. In the consideration of the dimensions and proportions of the *Drottning Victoria* the necessity for having a very steady vessel at sea was of prime importance, and a special feature of the form of ship is the provision of deep bilge keels in order to minimize any rolling tendencies. Briefly described, the *Drottning Victoria* is 370 feet long and 51 feet in the beam, and she is fitted with triple-expansion engines of sufficient power to enable her to cover the 65 miles between Sassnitz and Trelleborg within four hours. The trains enter the after end of the ship from a specially constructed quay and landing stage made exactly to suit the form of the vessel, and thus ensure perfectly smooth running and safety in embarking and disembarking. A complete train of eight bogie vehicles may be accommodated on board on two parallel lines laid to a gauge of 1.435 metres, and each having an effective length of 295 feet. During shipment complete steadiness is secured by a system of trimming tanks.

"Upon arrival on the car deck, the vehicles are secured to the deck by means of specially designed screws, spaced at intervals of 8 feet 8 inches on the outside, and at intervals of 4 feet 4 inches

in the centre of the track. These are attached to gun-metal shackle plates, and then screw jacks are placed under the cars to relieve the car springs. As a special precaution during heavy seas, provision is made for an additional screw attachment, extending from the top of the cars to the fore and aft girders of the structure of the vessel. The car deck is built so as to accommodate vehicles having a height of 15 feet 3 inches, and a width of 11 feet 2 inches—the maximum loading limits of the Prussian and Swedish State Railways.

"The propelling machinery of the *Drottning Victoria*, consists of twin-screw triple-expansion engines, with four boilers working under forced draught, 16 feet 4 inches diameter and 12 feet long. Air is supplied to the boilers by a fan 102 inches in diameter. The steam pipes of the main engines are of steel passing through separators. The main engines are of the following diameters: 23½ inch, 38½ inch, 63 inch and 36 inch stroke, working at a pressure of 185 pounds per square inch. The condensers are independent and are of circular form, carried upon the back column, each being served by a large pump fitted with double engines. Worked from the main engines is an air pump and bilge and sanitary pumps. The feed pumps are independent of the main engine. The discharge from each air pump is led into large hotwell tanks, arranged to filter the water previous to reaching the feed pump. An ash ejector is fitted in each stokehold for the discharge of ashes. The engines are fitted with Aspinall's governors, and amongst other auxiliary machinery are two large evaporators and feed and ballast donkeys. The trimming tanks, one being fitted on each side of the vessel abreast of the boilers, have each a maximum capacity of 90 tons, and there is provided in connection with these a 15 inch centrifugal pump, which quickly empties and fills the tanks, so as to counteract the load on one of the lines of the car deck.

"Apart from the system of shipping the vehicles on a separate deck, the design of the *Drottning Victoria* is of special interest, inasmuch as besides being a car ferry, she is provided with passenger accommodation but rarely equalled in cross-Channel steamers, and is in every respect a first-class passenger steamship having dining-room, saloon, smoking-room, lounge, ladies' room, and regal apartments, all on the promenade deck, while below the car deck there is sleeping accommodation for no fewer than 96 first-class and 45 third-class passengers. In the case of the night services between Berlin and Stockholm, it is probable that the occupants of the sleeping cars will not think it worth while to leave them; but as amongst the traveling public there will, no doubt, be some who prefer to move about, spacious accommodation is provided to meet their various needs."

THE FIXATION OF ATMOSPHERIC NITROGEN.

THE PRODUCTION OF ARTIFICIAL NITRATES BY THE PROCESS OF THE BADISCHE ANILIN- UND SODA-FABRIK.

Dr. A. Bernthsen—International Congress of Applied Chemistry.

A PROCESS for the manufacture of artificial nitrates from the air, which, like the Birkeland-Eyde process described in these columns in our last number, utilizes the electric arc for the production of oxides of nitrogen, but is fundamentally dissimilar to the latter in other respects, has recently been perfected by the Badische Anilin- und Soda-Fabrik and is being applied commercially on a large scale. A full technical account of the process will be found in a paper by Otto Schönherr, printed in the *Elektrotechnische Zeitschrift* for April 22 and 29. The essential details are described in the following extracts from a paper by Dr. A. Bernthsen, read before the recent International Congress of Applied Chemistry, which we have chosen for review because of its more direct comparison of the two leading processes for the manufacture of "air-saltpetre."

"The Badische Anilin- und Soda-Fabrik, after manufacturing indigo on a commercial scale, have recently paid

special attention to the new problem. As the result of these labours, Otto Schönherr succeeded in 1905 in discovering, and with the assistance of the engineer Hessberger, working out, a process of producing an electric arc, and was thus enabled to solve the problem in a surprisingly simple manner, presenting considerable advantages over the method of Birkeland and Eyde. It is not a mere modification of their process, as has sometimes been falsely assumed, but differs fundamentally from it, for while Birkeland and Eyde cause the electric discharge to burn in a strong magnetic field, and thus spread it out in the shape of a flat, more or less circular disc, Schönherr dispenses entirely with magnets and magnetic fields, and produces his arc inside an iron tube of comparatively small diameter, at the same time passing the air through the tube, and thus bringing it into contact with the arc. The manner in which the arc is developed is in itself very peculiar and interesting. The iron tube, or arc tube, as it is designated, contains an insulated electrode at one end, and can itself serve as the second electrode. The arc, at its formation, springs from the insulated electrode to an adjacent part of the arc tube, which is only a few millimetres away, but the air, which is passing through the tube, being preferably introduced with a tangential or rotary motion, immediately carries the end of the arc along the wall of the tube, so that it either enters the tube at a considerable distance from the electrode, or ends on a special electrode placed for the purpose, say, at the other end of the arc tube. A slight modification consists in using an arc tube of non-conducting material, and inserting in it a wire-spiral along which the end of the arc can travel, or providing other means for bringing about the initial formation of the arc. In each case, a column of arc flame is obtained, burning quietly in the axis of the tube, and surrounded by the air which is being passed through the tube. The arc, as seen through a mica-covered opening, emits an intense light, and is quiet stable, as opposed to arcs which are formed in the open air, since these latter are easily extinguishable. The air passing through the tube comes into contact with the arc, becomes partially converted into nitric oxide, and is then rapidly cooled down by contact with the outside layers of air, and consequently a decomposition back again to nitrogen and oxygen is avoided. The cooling action is still further increased by surrounding the upper end of the arc tube with running water, after the manner of the Liebig's condenser. The bases leaving the tube contain about 2 per cent of nitric oxide—that is, they are from one and a half times to nearly twice as concentrated as the gases which Birkeland and Eyde produce.

"The method of introducing the air can be very varied. For instance, instead of the air being passed in its entirety into the space between the electrode and the wall of the tube, it can be introduced partly or wholly into the tube at other points above or below the electrode, and it can be made to enter the tube either through one or more openings or through a number of openings which are distributed over a part or the whole of the tube. The opening may be in the form of a ring extending all round the tube, or several such ring-shaped openings can be employed, or instead of these, long slits, either parallel or at an angle to the axis of the tube, can be provided. The openings may be situated so that the air enters at right angles or at any other angle to the axis of the tube. In the latter case, the gases generally pass through the tube with a rotary motion.

"With the aid of Schönherr's invention, it is possible to send extraordinarily large quantities of electrical energy through a single tube. A small experimental apparatus, for instance, uses about 5.5 horse power and works at a tension of 5,000 volts. The experimental furnaces at Christianssand have a capacity of about 600 horse power at 4,200 volts, and although it appears possible to build furnaces which could consume 2,000 horse power, those regularly used will probably be built for 1,000 horse power. These furnaces require about 40,000 cubic feet of air every hour, and the arcs produced are nearly 8 yards long.

"The construction of the furnace on the large scale is as follows: The air passes into the arc tube through a number of tangentially-bored holes in the part of the tube surrounding the electrode, and over these holes is an iron ring or cylinder, which can be moved from the outside by means of a lever, so that any desired number of the holes can be closed, and consequently, the strength of the rotary motion of the air regulated, and this in turn assists in regulating the length of the arc. The insulated electrode can be cooled by means of water or air, and it is also provided with a central hollow space through which passes an iron rod. The arc actually springs from this iron rod, and as it burns or volatilises away, it can be pushed forward by a simple arrangement; the rate of burning, however, is very slow. An ignition lever, or other simple arrangement, is provided so that the arc can be started afresh, should it from any cause become extinguished; this, however, is very rarely the case. The furnace itself is connected electrically to earth, so that any part of the apparatus, with the exception of the insulated electrode, can be handled with impunity. The gases which leave the arc tube pass down a channel lined with brick, and concentrically surrounding the inner parts of the furnace. They are thus made to give up a portion of their heat to the air which is entering the furnace, and which is subsequently passed through the arc tube, thereby raising it to a fairly high temperature. The apparatus is extremely simple, and at the same time very durable; ordinary iron tubes are employed, there are no movable parts and no expensive electromagnets, and the manufacture runs smoothly without interruptions.

"Though in this process there is very little loss of electrical energy in producing the arc, yet only a small percentage of the energy serves to bring about chemical reaction, the rest is converted into heat. This latter, however, is not by any means wasted, 30 per cent of it is employed producing hot water, 40 per cent heats the boilers, 10 per cent has to be removed by cooling, and only 17 per cent is lost by radiation. The evaporation of the calcium nitrate solutions obtained is carried out solely by the heat generated in the arc.

"Numerous experimenters have studied the chemical action of this kind in arcs, and under certain conditions it has been found that a gas mixture containing 10 per cent of nitric oxide could be obtained. Having once obtained the oxides of nitrogen, it is necessary to bring them into a marketable state, either into the form of nitric acid, nitrates, or nitrites. Up to the present both nitric acid and nitrites have been manufactured from saltpetre by chemical reaction, and are, therefore, both more expensive than the latter substance. As, however, the demand for nitric acid and nitrites is limited, the chief aim of every large factory is to convert the supply of nitrogen into the form of saltpetre, for which there is an unlimited market. The nitrogen tetroxide passes through water, so that two-thirds of the nitrogen present is converted into nitric acid, while one-third reappears as nitric oxide. This again combines with the excess of oxygen present in the gases to form oxygen tetroxide, and the same reactions are gone through again. On neutralising this acid with soda a concentrated solution of sodium nitrate is obtained, which can be evaporated until the solid salt crystallises out. In practice limestone is, however, employed instead of soda, so that calcium nitrate is obtained. This substance is at least as valuable as sodium nitrate for manuring purposes, and is consequently isolated as such and put on the market under the name of "Norwegian saltpetre" or "air saltpetre." By other suitable methods strong nitric acids, nitrites and nitrogen tetroxide can also be obtained. The furnace gases can also be passed over quicklime, which absorbs them, the final product containing dry calcium nitrite.

"The calcium nitrate obtained can, without further treatment, replace Chili saltpetre for purposes of agriculture, and is in some cases even better. Even a mixture of calcium nitrate with nitrite and free lime appears to have no harmful effect. Such operations as these require abundant and cheap water power, which conditions the Birkeland and Eyde con-

cern have obtained in Norway. The Badische Anilin- und Soda-Fabrik have also obtained a concession whereby the construction of a factory with a capacity of 50,000 horse power will be possible.

"Considerable quantities of air saltpetre will shortly be put on the market, and probably, within a few years, the annual output will reach 100,000 tons. This quantity is none too large when we remember that the world's demand increases by at least that much every two years. Chili saltpetre is not likely to influence unfavourably the development of the factories already started, especially as air saltpetre has decided advantages over the old material, being free from perchlorate and other injurious compounds. Further, it contains lime which is very beneficial for the plant, whereas the soda in Chili saltpetre is very often directly harmful. Experiments made on this subject bear out these contentions."

INSURANCE OF LABOR IN AUSTRIA.

A DIGEST OF THE LAWS COVERING ACCIDENT AND ILLNESS INSURANCE AND OLD-AGE PENSIONS.

Engineering.

THE statutory establishment of general compulsory labor insurance in Austria considerably antedated the acceptance of the principle of workmen's compensation for accident in Germany and Italy. Systems of insurance against accident and against illness have been in operation in Austria for over twenty years; as already noted in these columns, they were established in Germany and Italy only in 1900 and 1904, respectively. The Austrian old-age pension system, however, is of very recent origin and has been in operation for less than two years. As described in *Engineering* for April 30, the three systems of insurance in Austria, against accident, illness and incapacity due to age, have many features of interest.

"In December, 1887, an Act of Parliament regulating the insurance of workpeople against accidents was passed. It provides for all classes of workpeople, including apprentices and students, and also for foremen, inspectors, and officials employed in and about practically all classes of private works, factories and mines, and in the building trades. By private works, etc., we have to understand all other than Government and municipal undertakings which had been dealt with by previous measures, and for whose workmen and officials ample provision was already made. The capital necessary for establishing this system of insurance was, in the first place, lent to the new undertaking by the Imperial Government. The loan, however, was of but a temporary nature, and the real working capital had to be subscribed by contributions made by employers and employés."

In determining the degree of risk run by persons employed in various industries, statistics of accidents were examined and the results studied and tabulated. Since the passage of the Act, statistics of accidents have been kept with extreme care, and the numbers representing the relative risks are revised quinquennially. Risk numbers of approximately equal magnitude are grouped together to form fourteen classes of risk, under which each undertaking to be insured is allotted its place. As, however, the risk of accident in various establishments of like nature depends largely upon the method of working and disposition of the plant, similar, and even neighboring, undertakings of a like character may be required to insure their hands at different rates.

"The premium for a given shop being fixed, the employer is required to pay 90 per cent of the sum due on account of each of his hands, and the employés have to pay the remaining 10 per cent out of their own private means. In many cases, however, the employer undertakes of his own free will to pay the whole of the premium. This is more especially the case in those works which had insured their hands before the law was passed. The premium being paid,

the workman is insured against the loss which he, or his dependents, would incur if he were injured by accident whilst at work for his employer. The sum for which an employé may be insured is limited; and any amount which he earns beyond 8 kronen (about 6s. 8d.) per day is neither taken into account when determining the premium to be paid, nor in fixing the amount of the reparation to be paid in case of injury or death.

"If, through injury due to accident, an insured person is unable to work during a period not exceeding four weeks, the case is dealt with under the law regulating the support of employés during illness. If, however, a workman is laid up for a period greater than four weeks, he is entitled, during the time he is unable to work, to support at a rate equal to 60 per cent of the wages he, on an average, earned per week during the previous twelve months. Should he be but partially incapacitated, the amount of support is proportionately reduced, and can at the most attain to 50 per cent of the sum he would have obtained if he had been totally disabled." In case of death due to accident, two pounds are subscribed by the insurance society toward the cost of burying the insured person. In the case of a married man, the widow is endowed with an annuity equal to 20 per cent of his average income during the twelve months before his death, each legitimate child with an annuity of at least 15 per cent of the father's income, and each illegitimate child with an annuity of 10 per cent. The total sum of such endowments, however, may not exceed 50 per cent of the income which the deceased was, on an average, earning at the time of his death. In the case of an unmarried man, parents or grandparents can, in case of need, claim an annuity equal to that granted the widow of a married man.

"In 1888 a second bill was passed, providing for the support of employés when detained from work through illness. As in the case of accident insurance, the capital required to work this institution is partly subscribed by the employers and the rest by the insured persons themselves. The greater part of the premium for insurance against accident must, as we have seen, be paid by the employer; for it is to his advantage, and under his direction, that the risk of accident is incurred. Illness is another matter. Employés spend only about 27 to 34 per cent of the year upon their employer's premises and at his service. It appears, therefore, quite reasonable that the employés should pay, as they do, the major part of the premium for insurance against illness."

The premium rates vary somewhat according to the nature of the work and the climatic conditions of the neighborhood. The society connected with the general engineering establishments in and about Prague may, however, be taken as a typical example. "To this society the employés are required to pay 2.5 per cent of their normal weekly wages, and the employers augment this premium by a sum equal to 60 per cent of that paid by each insured person. The employer, therefore, pays at the rate of 1.5 per cent of the men's normal weekly wages."

In case of illness, the insured is entitled to free medical treatment, free medicine and the free use of any medical or surgical apparatus required. For twenty weeks after the first three days of inability to work, the insured is entitled to financial support from the society to an amount equal to 60 per cent of his normal weekly wage. In cases of especial need, the society may continue to assist him after the expiration of the twenty weeks at a rate equal to not more than half that which he could originally claim. Assistance for a period of more than one year is, however, forbidden by law. If hospital treatment is necessary, the society is required to pay the cost of the patient's transport thither and of his treatment there for a period not exceeding four weeks. In the case of unmarried men, or those upon whose earnings no others are dependent, hospital treatment is considered as equal to the sum total of all benefits due them while in the hospital. In the case of married men, or of persons having others dependent upon them for sustenance, the society is required to pay one-half of the sum due to the patient, were he ill at

home, to those dependent upon him. When an insured person dies through illness, the society is required to contribute a sum equal to twenty times his last daily wage toward the burial expenses.

The Act providing for old-age pensions for officials, assistants and clerks in other than government or municipal employ (a system of government and municipal pensions was already in operation) was passed in December, 1906, and came into force on January 1 of last year. The pensions are provided by the "accumulated capital subscribed conjointly by the individual private servant and his master. The capital is provided in a way very similar to those described in connection with accident and health insurance. In this case, however, the Government contributes 100,000 kronen (£4,166) per year towards the working expenses of the undertaking. This sum is to be expended in paying the salaries of its chief officials.

TABLE OF OLD AGE PENSIONS AND PREMIUMS.

Class.	Income per Year.*	Premium. Per Month. Employé's Share.	Premium. Per Month. Employer's Share.	Pension. After Ten Years' Service, Per Year.	Pension. Increase for Each Further Year of Service.	Pension. Maximum after 40 Years of Service.
I.	600 to 900	2	4	180	9	450
II.	900 " 1200	3	6	270	13.50	675
III.	1200 " 1800	4	8	360	18	900
IV.	1800 " 2400	6	12	540	27	1350
V.	2400 " 3000	12	12	720	36	1800
VI.	3000 & more	15	15	900	45	2250

* All values are stated in kronen, 24 of which are approximately equal to £1.

"The insured, who must be at least eighteen years of age, are divided into six classes, according to the amount of their incomes, and they ascend from class to class as it increases. The premiums payable are tabulated in the table above. Reference to it will show that private servants whose income is less than 600 kronen (about £25) a year are not provided for by the law, as it is deemed that such persons are still apprentices, students or improvers, and not servants likely to remain with their present masters for any lengthy period of time. Servants whose income exceeds 3,000 kronen (£125) per year can only be insured to the extent set forth in the table, and their income beyond that amount is to be left out of consideration when calculating premiums and benefits.

"The persons insured are entitled to the following benefits:—

(*a*) A pension for themselves—

1. If, at any time, permanent total disablement is caused by an accident incurred whilst performing the duties of their office.

2. If, after having been insured for a period of at least ten years, they are, for any reason, totally incapable of performing the duties of their office.

3. After having completed 40 years' service.

(*b*) An annuity for their wives and children—

1. If killed by an accident whilst performing their duties.

2. If, after being insured for a period of at least ten years, death occurs from any cause.

"The widow's annuity is fixed at half the amount to which her husband, if living, would have been entitled if permanently totally disabled. Each legitimate child less than eighteen years of age, who, after the death of the insured parent, has still one parent living, is entitled to an annuity equal to one-third of the amount that the deceased parent would have received if living in a permanently disabled condition. If both parents are dead, this annuity is doubled.

"The management of each of the three insurance undertakings in which we are interested is jointly in the hands of the Imperial Government, of the employers, and of the servants. In the case of accident insurance, the law requires that each country ruled by the Austro-Hungarian Imperial and Royal Government shall have its own insurance society, and that its management shall be placed in the hands of a committee of eighteen persons. One-third of the members of this committee are appointed by the Crown; the remaining two-thirds are elected in equal numbers by the two parties interested. This committee has to elect a president, vice-president, and three of its members (one each from among the representatives of the Government, of the employers, and of the servants), to attend to the ordinary business of the undertaking. Only these

five members of the committee are remunerated for their services. The full committee is simply a controlling organ, and meets but once a month.

"In the case of insurance against illness, each industrial district has a central insurance office of its own, and the various industries of the district are clubbed together to form sub-branches. Each sub-branch is a self-ruling body, subject, however, to the local central office. The officials are elected by the interested parties, as above, the Government only controlling the financial reports and committee-meeting minutes of the various sub-branches and central offices.

"The pensioning scheme will be managed in a way similar to that already described in connection with accident insurance, excepting that the committee will consist of but ten members (five elected from among the employers, and five by the servants from among themselves), and be presided over by a president appointed by the Crown."

FUELS FOR INDUSTRIAL FURNACES.

A DISCUSSION OF THE RELATIVE ECONOMY OF PULVERIZED COAL, OIL AND GAS.

William D. Ennis—Brooklyn Engineers' Club.

AT the close of a series of two articles on the industrial applications of pulverized coal, contributed to this Magazine in December, 1907, and January, 1908, Prof. William D. Ennis referred very briefly to the use of this fuel for firing heating furnaces of all kinds. In a subsequent paper, read before the Brooklyn Engineers' Club, Prof. Ennis has covered practically the same ground as in his articles in THE ENGINEERING MAGAZINE, but has given a considerable amount of attention to the relative advantages and economy of pulverized coal, oil and gas as fuels for industrial furnaces. This part of his paper we reproduce in full from the last number of the Club's *Proceedings*.

"One of the most promising fields for the application of pulverized coal is in the operation of heating furnaces of all kinds in engineering works. This is being well exploited. At Lebanon, Pa., the American Iron and Steel Manufacturing Company has an elaborate pulverizing plant, including a duplicate-unit installation of tube mills driven by Westinghouse engines, and an extensive system of distribution. The coal used shows: Fixed carbon, 58.49; volatile, 31.97; moisture, .52 (as fired); ash, 9.02, and sulphur, 1.34. The heating value is 13.721 B. t. u. per pound. The fuel is fed by double return-screw conveyors. It is used in roll-furnaces, rivet and bolt furnaces and for heating operations of all kinds, replacing both coal and oil. In the latter case, the saving in cost of fuel was the determining argument for the installation; in the former, greater speed of operation, controllability of temperature and less trouble with workmen, led to the adoption of the new fuel. In many metallurgical operations, particularly those in which rather small amounts of fuel are involved, economy of fuel is a minor consideration. Speed of production, convenience, ease of manipulation, are all of much greater consequence. Where pulverized coal is not employed, oil is often used, in spite of its high cost. It pays to use it. In such cases, it would certainly pay to use pulverized coal, which is much cheaper than oil. The only exception would be in the case of a very small plant, which could not stand the expense of a pulverizing outfit. The machinery is now being made in very small units, however, so that this objection will be partly, at least, eliminated. In small furnace applications, while economy of fuel is not especially regarded, pulverized coal often leads to such economy, as well as to the larger gains mentioned. This is particularly the case in furnaces heating small parts, like bolts and rivets, in which a large saving follows control of the temperature at various points in the furnace. The same gain is, in fact, found with oil, which, in spite of its higher cost per heat unit, may cost not much more, per pound of metal heated, than ordinary

coal. In one large forging furnace, in which pulverized coal replaced ordinary slack, the fuel cost per pound of metal was decreased 67 per cent, while the output increased 50 per cent. One would scarcely expect to find the fuel saving so great, particularly as the furnace was used on billets 15 inches square and 8 feet long. The increase in production is less, however, than is usually possible. In a plow-beam furnace, where the pieces heated are small, the output increased 300 per cent. In competing with oil, pulverized coal will, of course, not increase furnace output; but it will undoubtedly greatly decrease the cost of fuel.

"Such savings in fuel cost, as compared with oil, and in production and convenience as compared with coal, are possible in a host of applications, such as varnish kettles, annealing furnaces, drop-forge furnaces, brass foundries, enameling ovens, cable-coating machines, flanging furnaces, steam-hammer furnaces, rivet, bolt, nail and spike furnaces, etc. None of the fuels mentioned, including natural gas, can compete with it. The General Electric Company, at Schenectady, is using fuel oil for most of these minor applications. When the aggregate expenditure for oil in a plant of this kind is considered, the opportunities for saving are clearly enormous.

"In furnace applications of the nature described, it is obvious that there is no need for any exceptional efficiency on the part of pulverized coal to offset the cost of preparation. The fuel is *per se* far more efficient, even when this cost is considered, than solid fuel. The only question is whether it is the most efficient of all the fuels available. So far as fuel-oil competition is concerned, the problem may be briefly stated. In small plants, where the furnace-fuel item is not a large element of the cost of production, oil may continue to be used. In plants which are sufficiently large to warrant the installation of a pulverizing plant, powdered coal may replace oil. With oil, it is true, there is no large initial expenditure necessary, but the lower cost of powdered coal per unit of heat will soon pile up a saving large enough to offset the first cost of the plant.

"There is another competitor from which pulverized coal has more to fear; that is, gas. Gas is entirely adaptable to every kind of furnace application, with efficiency in combustion quite equal to that attainable with either fuel oil or pulverized coal. At the price at which illuminating gas is commonly sold it is from five to thirty times as expensive as coal; natural gas is also usually expensive. Producer gas, made by the consumer himself, is very cheap. Its preparation requires an expensive plant, though much less expensive than that necessary for pulverizing coal. The efficiency of gas-making, producing pure carbon monoxide from pure carbon, is theoretically only 70 per cent, if the sensible heat of the gas is not credited. In engine work, this is the maximum possible efficiency under the stated conditions, because the sensible heat of the gas is of no use; indeed, it is a positive detriment. We have found that what may be called the efficiency of pulverizing coal is about 90 per cent, when the saving in fire-room labor is credited. In furnace applications, the efficiency is lower, but still easily 80 per cent; so that obviously, the theoretical producer gas, made from the same fuel, is more costly than pulverized coal.

"In furnace work, however, the sensible heat of the gas is all available, and the efficiency has a limiting value of 100 per cent instead of 70 per cent. Just how closely we may reach this value depends on many conditions, but noticeably upon the extent of distribution. The loss is then principally that due to the radiation of heat during transmission of the gas. This may be compared with the loss due to the power consumption necessary to distribute pulverized coal over the plant. In both cases, efficiency is to be attained by installing the fuel-preparing plant close to the furnace.

"The gas to be used is manifestly not the continuous-process producer gas made by an air blast alone, which has a heating value of only about 1480 B. t. u. per pound, but a modified gas, obtained by using a steam blast with the air. This will produce a more concentrated gas, containing hydrogen, so that for a given bulk handled, a greater heating power

will be carried to the furnace. The process may be carried so far as to produce semi-water gas, the steam blast being applied until the fire is chilled, and air then injected alone for a time. The efficiency on a cold gas basis is greatly increased by the use of steam, and the loss of sensible heat in transmission becomes greatly reduced. A theoretical cold gas efficiency of 80 per cent can easily be attained while using steam continuously, and intermittent use permits of even higher efficiencies than this.

"Industrial gas, seems then to present even greater ultimate opportunities for saving than pulverized coal. It can be more advantageously applied in small installations at the present time. Its use is not popular or general, any more than is that of the coal, largely on account of its newness. Many plants that have been installed have failed to give satisfaction. The objections arise not from low efficiency, but from a lack of reliability. One large works has met with so disappointing an experience that it has adopted a general policy of returning to the use of oil.

"Neither gas nor pulverized coal has as yet passed the initial stage of commercial application, though for furnaces and kilns the latter may be fairly said to have passed the experimental stage, while the former has not. It is not impossible that the two may prove such close competitors that both will have a wide field. Certainly in this part of the country either should displace fuel oil, which is essentially the lazy man's fuel. That one or both of the two will eventually be generally applied in industrial furnace operations seems undoubted."

METALLIC-FILAMENT LAMPS AND THE ELECTRICAL INDUSTRY.

AN OPTIMISTIC VIEW OF THE EFFECT OF THEIR GENERAL INTRODUCTION ON THE ELECTRICITY-SUPPLY INDUSTRY.

E. E. Hoadley—Incorporated Municipal Electrical Association.

UNLIKE the majority of recent writers on the subject, Mr. E. E. Hoadley, who recently read a paper on the influence of metallic-filament lamps on the electrical industry before the Incorporated Municipal Electrical Association, which is abstracted in *The Electrician* for June 25, regards the advent of the high-efficiency lamp as a blessing to the electricity-supply industry, though possibly in disguise for a time, for the loss of revenue at the present time will be amply repaid later on. In many cases, of course, there will be a fall of revenue more rapid than can be compensated by any increased demand at the moment, and in some few cases the raising of rates may seem to be the only possible solution of the difficulty. Generally, however, the remedy lies in exploiting as far as possible the other domestic uses of electricity, such as heating and cooking, which so far have been comparatively neglected.

As to the results to the electricity-supply industry he says, "it is practically impossible to take a single example, and, after exhaustively studying the facts presented, to lay down general rules or to make general deductions. The result of the introduction of the metal lamp varies according to whether the station supplies alternating or continuous current, whether the output is solely for lighting, or is made up of power, lighting and traction; and if the supply is practically a lighting supply whether that supply has a large proportion of shop lighting, or is to a great extent residential. Taking the case of the alternating-current stations first, these may be roughly divided into two classes—those stations in manufacturing districts supplying two or three-phase current and having a large proportion of their output used for power; and the single-phase stations, most of them of somewhat ancient date and generally supplying an area in which the demand is chiefly for the lighting of residential property.

"Considering the latter case first, as it is undoubtedly these stations which will feel the pinch first and will feel it hardest. Generally the property they supply is of the better class; houses whose owners will face the outlay demanded by a

transformer and metal lamps with equanimity. In most cases the houses supplied are sufficiently well lighted already, and the same amount of light for a greatly reduced amount of money will be obtained. In most of the towns in question gas is not particularly cheap, so that a large proportion of the available houses already take a supply; thus, purely for the lighting supply, it is doubtful if new consumers will come along fast enough to take all the units that existing consumers will save. Even if they do, it means that the capital charges per unit sold will be increased, as although the generating plant will not need addition, yet new mains and services must be provided, and in such residential towns these are generally an expensive item per consumer, and with the poor load factor generally prevalent, capital outlay should be kept as low as possible. To stations of this class it must be confessed that the outlook is not particularly rosy for the next few years, and it can hardly be wondered at that several are considering the raising of prices. In some special cases this may be the right policy, but the author is of opinion that what may be called the domestic uses of electrical energy should be pushed as widely and as hard as possible —heating and cooking in the better class houses are not exploited nearly as much as they should be.

"Where an alternating-current station has the benefit of a good shop lighting load and at the same time supplies a fair amount of power the metal lamp should be looked on as a blessing in disguise, for a short period if you will, but still as a blessing, for the amount of harm done to the revenue account now will be amply repaid later on.

"Most engineers of continuous-current stations, particularly of those where the pressure is 200 volts or over, look with distinct favor on the lamp, but even they must look further than some of them have done up to the present, namely, to the time when a lamp of 16 candle power, or even smaller, can be obtained for all pressures commonly in use, and at a price which will be but little in advance of the selling price of the ordinary carbon filament lamp. It is all a question of supply and demand—a parallel case can be cited in the case of the gas mantle."

To get the utmost good from the metallic-filament lamps it is practically necessary that central stations, whether publicly or privately owned, should have the legal right and the ability to raise money for the purpose of wiring houses and other premises, and for letting out cooking and heating apparatus on hire and hire purchase. "Next to the above comes the necessity for cheaper wiring. A large number of systems of cheap wiring are now in course of evolution and the success already obtained with some of them has provoked the ire and the pens of interested parties. The author can state from his own experience that the Continental system of flexibles on special insulators requires a lot of beating —among other places, he has tried it in the damp warm atmosphere of a conservatory for 18 months without the slightest trouble. With cheap wiring, the necessary powers to hire out cooking and heating apparatus, wiring and fittings, and the improvements in cooking and heating apparatus which are bound to come with extended experience, most central stations should be able to look on the metal lamp as an ally and not as an enemy. To the above advantages should be added the very important fact of a large reduction in the selling price of the lamp.

"Provided it can be arranged that central stations can obtain the advantages set out above, viz., extended powers, cheaper wiring and cheaper lamps, it is the author's opinion that a new era of prosperity for the greater part of the electrical industry will begin, and in the meantime supply engineers should do their utmost to counteract any disadvantage there may be in a falling revenue from purely lighting consumers, by pushing into prominence the many other uses of electrical energy, some of which have been seriously neglected.

"In the field of public street lighting the importance of the new invention cannot be over-estimated; up to the present its full effect has not been considered, and the author feels sure that when engineers and committees responsible for the lighting of streets have fully realized

the possibilities of a lamp with an efficiency of approximately 1 watt per candle-power, that can be obtained in single units giving candle-powers ranging from 50 to 1,000, there will be many schemes of street lighting by arc lamps and by incandescent gas that will be altered and modernized. Up to the present most streets lighted by incandescent gas at ordinary pressures, in towns where electric light mains are laid, are so lighted chiefly on the score of cheapness, the supporters of gas lighting claiming that electric light was beaten in the competition, as the light given by carbon or other lamps available up till recently was not equal to the light of an ordinary gas mantle; while for many streets the cost of arc lighting, even with the lamps spaced as far apart as possible, was prohibitive. Whatever truth there was in these statements then has considerably altered now, for an ordinary 60-watt metal lamp without any reflector will, from the point of view of the ordinary public, produce the same results as a good gas mantle in the heyday of its youth, while with reflectors the effect can be considerably increased. The other advantages, from an electrical point of view, are that no special mains are necessary, with the same fitting different candle-power lamps graded according to the importance of the streets can be employed, lamps that fail can be renewed at any time without trouble, the candle-power of the lamp does not appreciably diminish with age, and last, but not least, the average life of the lamps is a revelation. In the author's own experience, some 18 months has given an average life of very nearly 1,100 hours, individual lamps lasting 6,750, 5,450 and 5,044 hours on a circuit at 230 volts where a large and fluctuating power demand does not make for a particularly steady volt chart.

"In conclusion, the author would urge all station engineers to unite in trying to obtain what he considers the necessary powers to enable them to utilize to the full the immense power put into their hands by this epoch-marking invention, and by themselves getting into personal contact with their consumers, putting before them the great advantages of more light for the same money instead of the same light for less money."

OIL ENGINES FOR CENTRAL STATIONS.

A COMPARISON BETWEEN STEAM, GAS AND OIL POWER FOR MEDIUM-SIZED PLANTS.

A. J. J. Pfeiffer—Institution of Electrical Engineers.

THE claims of the oil engine working on the Diesel principle to recognition as a competitor of steam and gas engines in central-station design are presented in a recent paper by Mr. A. J. J. Pfeiffer before the Institution of Electrical Engineers. The author notes that in the discussion of the comparative merits of steam and internal-combustion prime movers the gas engine is almost universally accepted as the only practicable representative of the latter. Oil engines, however, are now built in units up to 800 horse power, and manufacturers are prepared to construct units up to 4,000 horse power. Now that the limitations of size are so far removed the peculiar advantages of this type of prime mover may be expected rapidly to win for it a position of importance in the central station field. Mr. Pfeiffer directs special attention to its superior economy of operation as compared with steam and gas engines.

In speaking of "oil engines," Mr. Pfeiffer refers only to those working on the Diesel principle, since only that type up to the present is constructed in sizes large enough to be considered a factor in central-station design. The cycle of operations is as follows: Air at atmospheric pressure and temperature is drawn into the cylinder; this air is compressed to about 450 to 500 pounds per square inch and the temperature rises to 900 to 1,000 degrees F., far above the ignition point of oil; oil fuel at a constant pressure of 700 to 800 pounds per square inch is blown into the cylinder a little before the end of the compression stroke, by means of air compressed by a special pump, combustion takes place and the

products of combustion do work by expansion; the waste gases are exhausted to atmosphere, the exhaust pressure at the cylinder being about 40 pounds.

"The principal difference between the Diesel oil engine and the ordinary gas engine lies in the fact that only the air used for combustion is compressed, the fuel being gradually injected after this compression of the air has taken place, the resultant great advantage being the elimination of the possibility of premature ignition, no sudden increase of pressure, and, therefore, less strain on the working parts. Manufacturers of Diesel engines are now following closely in the footsteps of the gas engine development, and are adopting the two-cycle and also the double-acting principle for large units, giving one, two, or four working strokes per revolution. To obtain the two-cycle result, the principle of scavenging is resorted to by blowing fresh air at a pressure of 5 pounds into the cylinder near the end of stroke 3, clearing out the waste exhaust gases and filling the cylinder with a new charge. Strokes 1, 3 and 4 of the four-cycle engine are thus combined.

"The size of oil engines working on the Diesel principle has increased rapidly of late. Three to four years ago a 450 brake horse power unit was the largest actually running, while to-day there is in service a verticle 800 brake horse power set of the four-cylinder single-acting four-stroke type, having a speed of 150 revolutions per minute. This latter engine has only the cylinder and air pump water jacketed, and it is probably the limit of size to which engines can be constructed without having recourse to water cooling the piston, exhaust valves, etc. For larger outputs some manufacturers are devoting themselves to the development of the two-cycle engine, the largest at present running, being of 750 brake horse power, while others of equal repute are adhering to the simpler and less complicated four-cycle principle, their latest design being based on the horizontal twin-tandem double-acting type, giving four working strokes per revolution, and on this design they are prepared to construct units up to 4,000 brake horse power."

As regards reliability and simplicity, so important in the operation of a central station plant, this type of oil engine leaves nothing to be desired, and as far as the latter factor is concerned the oil engine plant is certainly much superior to either steam or gas. The engine is started up a few minutes before work is expected of it; the costly standby losses of a steam or gas generating plant are entirely avoided. All labor in connection with fuel handling is done away with, and, in consequence, the wages bill of an oil engine plant is about one-half to two-thirds that of a steam or gas plant. Another advantage of the oil engine is that once it is thoroughly well installed and adjusted it is much more fool-proof than either a steam or a gas engine.

Like a gas engine the overload capacity of an oil engine is limited to about 15 to 20 per cent., and this must be taken into consideration in connection with plants designed on very close margins between maximum loads and total kilowatts installed. The speed regulation approximates easily to that obtained in a steam engine and can be made to come to within 3 per cent., or even less, between no load and full load. As regards satisfactory conditions of parallel operation, a speed variation of 1-250th to 1-300th can easily be obtained with a four-cylinder four-cycle single-acting engine with a small fly-wheel. To obtain the same result with three cylinders, however, requires a flywheel of cast steel, the use of the ordinary heavy cast-iron flywheel being advisable only for speed variations up to 1-160th.

The type of engine under consideration can burn almost any liquid fuel; petroleum residue, gas oils and paraffin oils are successfully employed in England and on the Continent. Of late a new source of oil fuel has been found in gas plants. Carburetted water gas plants give off an oil tar as by-product which makes an admirable oil-engine fuel with a calorific value of about 0.9 that of crude petroleum, or about 16,500 B. t. u. per pound. So far as crude petroleum is concerned, the reliability of supply and the price fluctuations may be regarded as no worse than coal. At present the price in England is between 50s. and 55s. per

ton, in South America, about 60s., and in India, 45s. to 50s.

Mr. Pfeiffer chooses as a basis of comparison a plant dealing with a maximum effective load of 1,600 kilowatts, and considers three types of load, lighting, combined lighting and power, and traction, having annual load factors of 17.5, 33 and 52 per cent. respectively. The division of engine units is assumed as follows: for the 17.5 per cent. load factor, five 400-kilowatt sets (one reserve) and one 100-kilowatt set; for the 33 per cent. load factor, four 400-kilowatt sets (one reserve) and two 200-kilowatt sets; for the 52 per cent. load factor, five 400-kilowatt sets (one reserve). In the first case the total capacity of the installation is 2,100 kilowatts, in the other two, 2,000 kilowatts. In each case it is assumed that five (one reserve) units are provided for both boiler and producer plants.

A consideration of first cost leads to the conclusion that the difference in capital outlay between strictly high-class steam, gas and oil plants is but nominal. Mr. Pfeiffer estimates the total cost of buildings and equipment for steam, gas and oil plants at, respectively, £24.5, £23.5, and £23 to £25, per kilowatt installed. Fuel consumptions are worked out on the basis of consumption per effective kilowatt-hour output, consumption covering standby losses, and an allowance, ranging from 20 to 5 per cent., to cover inefficient handling, loss of efficiency in the plant, etc. The overall thermodynamic efficiencies of steam, gas and oil plants as derived from fuel-consumption data are, respectively, 5.6 to 8.7 per cent., 11.7 to 14.5 per cent., and 25.7 to 27.8 per cent, for load factors between 17.5 and 52 per cent. For the same range of load factor, the actual fuel consumptions for the three types of plants are estimated, respectively, as 4.67 to 3.08 pounds, 2.25 to 1.82 pounds, and 0.72 to 0.66 pounds per unit generated. Again for the same range of load-factor, the total works cost per effective unit generated, including cost of fuel, oil, waste, water, stores, salaries and wages, and maintenance and repairs, varies from 0.666 to 0.422 pence for steam plants using coal at 15s. per ton, 0.585 to 0.418 pence for gas plants using coal at 25s. per ton, and 0.436 to 0.338 pence for oil plants when crude petroleum costs 60s. per ton. Mr. Pfeiffer concludes that these results show that the internal-combustion engine working on the Diesel principle possesses advantages both from a technical as well as a commercial standpoint which will make this type of prime mover a most important factor in future central-station practice. Its limit of application depends primarily upon relative fuel costs; it probably cannot compete with steam or gas engines in the immediate neighborhood of coal centres, but where coal costs are high, it undoubtedly possesses overwhelming advantages over steam and gas engines.

The superior economy within certain limits of fuel costs of the Diesel engine in central-station work leads to the question whether the Diesel plant can successfully compete with, or, rather, take the place of, sub-station distribution, especially in connection with very large systems where generating costs are low. Mr. Pfeiffer takes the case of a large distributing system in London, having an outlying central station feeding ten sub-stations, each having the output of the oil-engine plant considered above. Transmission is by means of high-tension underground cable, each station being debited with five miles of duplicate cable, and conversion by means of transformers and rotaries, the transmission and conversion loss being 14 per cent. It is estimated that the capital cost of the ten local Diesel plants, based on two-cycle engines, would be £560,000, as against £635,000 for the central-station sub-station scheme. The difference in operating cost in favor of the Diesel plants would be, for the same load factors already considered, respectively, 0.22, 0.122, and 0.084 pence per effective unit. Mr. Pfeiffer concludes that the oil engine should be considered in connection with extensions to existing central stations, or in cases where it is a question of supplying power at points so far removed from the main station as to involve heavy additional capital and operating expenditure in connection with transmission and conversion.

THE ENGINEERING INDEX

"THE KEYSTONE IN THE ARCH OF APPLIED SCIENCE"

The following pages form a descriptive index to the important articles of permanent value published currently in about two-hundred of the leading engineering journals of the world—in English, French, German, Dutch, Italian, and Spanish, together with the published transactions of important engineering societies in the principal countries. It will be observed that each index note gives the following essential information about every publication:

(1) The title of each article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the articles themselves, if desired.*

The Index is conveniently classified into the larger divisions of engineering science, to the end that the busy engineer, superintendent or works manager may quickly turn to what concerns himself and his special branches of work. By this means it is possible within a few minutes' time each month to learn promptly of every important article, published anywhere in the world, upon the subjects claiming one's special interest.

The full text of every article referred to in the Index, together with all illustrations, can usually be supplied by us. See the "Explanatory Note" at the end, where also the full titles of the principal journals indexed are given.

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CIVIL ENGINEERING.

BRIDGES.

Arches.

The Spandrel-Braced Two-Hinged Arch (Der Zweigelenkbogen mit Zugband). Th. Landsberg. Mathematical discussion of the method of determining the stresses in the members. Ills. 5500 w. Zeitschr d Ver Deutscher Ing—June 5, 1909. No. 6722 D.

Blackwell's Island.

The Strength of the Queensboro Bridge. Henry S. Prichard. Analysis of the various reports on the safety of the bridge. Also editorial. 9000 w. Ind Engng—July 15, 1909. No. 6678 C.

Cantilever.

Erection of the New River Bridge at Glen Lyn, Va., by the Cantilever Method. L. L. Jewel. Illustrated detailed description of the structure and methods of erection. 3000 w. Eng News—July 8, 1909. No. 6223.

Concrete.

An Elastic Arch Concrete Bridge. Illustrated description of a reinforced-concrete arch treated as a perfectly elastic structure. The bridge, which carries a highway over railroad tracks, is known as the Scenery Hill Viaduct. 1500 w. Eng Rec—June 26, 1909. No. 6002.

We supply copies of these articles. See page 1048.

Design.

Stray Thoughts on Bridge Design and Maintenance. Herbert C. Keith. Extracts from a paper read before the Conn. Soc. of Civ. Engrs. Discusses timber floor details, cast-iron shims in trestles, paint, etc. 2500 w. Eng News—July 29, 1909. No. 6772.

Erection.

Erection of the Tremont Avenue Bridge, New York. Illustrates and describes an ingenious system of erection with powerful steel derricks and a gallows frame. 2000 w. Eng Rec—July 3, 1909. No. 6173.

The Erection of the Richelieu River Bridge. Illustrates and describes methods of erecting double track spans, to replace single-track spans, using old piers, without interfering with regular trains on the Grand Trunk Ry. 1000 w. Eng Rec—July 24, 1909. No. 6647.

Failures.

The Peoria Bridge Failure. Account of the collapse of a concrete bridge, due to bad foundations. Ills. 1800 w. Cement Age—July, 1909. No. 6442.

Maintenance.

See Design, under BRIDGES.

Masonry.

On Preservation Work at the Old Bridge of Ayr. Arthur Hamilton Wilson. Describes pointing the surface of the bridge, construction of cross walls, etc., underpinning the piers, cutting out and replacing damaged stones. Ills. 1200 w. Inst of Civ Engrs—No. 3798. No. 6450 N.

Reinforced Concrete.

Concrete in the Galveston Causeway. H. Prime Kieffer. Illustrates and describes the construction of this causeway, which will join the island to the mainland, and especially the extensive use of concrete. 2500 w. Mfrs' Rec—July 15, 1909. No. 6318.

Steel.

Difficult Bridge Work in Great Britain. A short summary of interesting erection work, with illustrations. 3500 w. Eng News—July 1, 1909. No. 6085.

A Curious Highway Bridge. S. E. Fitch. Illustrated description of a structure near Havana, Cuba. 500 w. Eng News—July 8, 1909. No. 6228.

The Fort Snelling Bridge. Illustrated detailed description of the design and construction of this highway bridge across the Mississippi river. 1700 w. Eng Rec—June 26, 1909. No. 5999.

Short-Span Bridges Over City Crossings. Illustrates and describes the short-span steel bridges recently built under agreement of the City of New York, in connection with extensive railway improvements. 3000 w. Eng Rec—July 10, 1909. Serial. 1st part. No. 6257.

See also Erection, under BRIDGES.

Viaducts.

A Reinforced-Concrete Viaduct With Some Structural Steel Reinforcement, Takoma Park, Md. Illustrated description of a structure in which I-beams are employed as the basis of the reinforced-concrete beams and struts wherever possible. 1000 w. Eng News—July 1, 1909. No. 6084.

CONSTRUCTION.

Columns.

The Rankine-Gordon and Euler's Formulae for Columns. W. E. Lilly. Aims to show that if the analysis on which Euler's formula is based is correctly interpreted, it really leads to the Rankine-Gordon formula; and that if Euler's formula is rational, so also is the Rankine-Gordon formula. 1300 w. Engng—July 2, 1909. No. 6302 A.

The Strength of Compression Members. Edward Godfrey. Aims to show that the strength of a column considered as a spring is independent of the elastic strength of the material. Also that the Gordon-Rankine formula leads sometimes to dangerous conclusions. 3000 w. R R Age Gaz—July 2, 1909. No. 6128.

Concrete.

Recent Examples of Concrete Construction. J. F. Springer. Illustrates and describes recent work, showing the progress in the use of plain and reinforced-concrete. 3500 w. Cassiers' Mag—July, 1909. No. 6349 B.

A Concrete Mixing and Handling Plant for Constructing a Dam, With Some Details of Cofferdam Work. Illustrates and describes the plant used in constructing a dam across the Connecticut River, at Bellows Falls, Vt. 1200 w. Engng-Con—June 23, 1909. No. 6018.

Contractors' Plants.

A Simple Plant for Building a Dam and Reservoir. Illustrates and describes a convenient and cheap construction system adopted at Russelville, Ark. 900 w. Eng Rec—July 10, 1909. No. 6253.

The Construction Plant for the Gatun Locks of the Panama Canal. Illustrates and describes the more important details and general layout of the plant for the handling of stone, sand and cement, the mixing and placing of the concrete, and the main power station. 3500 w. Eng Rec—July 17, 1909. No. 6396.

Cost Estimating.

Cost Estimating; A Discussion of Principles with Actual Estimates for Contract Work. Jean Bart Balcomb. 6500 w. Engng-Con—July 14, 1909. No. 6333.

Cost-Keeping.

The Cost-Keeping System of the United States Reclamation Service. Describes methods of giving a uniform sys-

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tem so that projects can be compared where conditions are similar, especially adapted to government work. 3500 w. Eng Rec—July 10, 1909. No. 6256.

Factories.

Materials and Methods of Construction for Industrial Buildings. J. P. H. Perry. Compares the qualities and costs of reinforced-concrete and mill construction. 4500 w. Engineering Magazine—Aug., 1909. No. 6753 B.

Failures.

Failures in Engineering Constructions. Dr. Charles B. Dudley. From the presidential address to the Am. Soc. of Test. Mat., June 29, 1909. A discussion of the causes and the question of responsibility. 4000 w. Ir Age—July 1, 1909. No. 6061.

Foundations.

Foundation for the Building for the U. S. Naval Experiment Station at Annapolis, Md. Harrison W. Latta. Describes the conditions and the methods used in constructing pile foundations and fill. 3000 w. Pro Engr's Club of Phila—Jan., 1909. No. 6360 D.

New Methods of Building Foundations in the United States (Nouvelles Méthodes employées aux Etats-Unis pour la Fondation des Bâtiments). Edmond Henry. Describes recent practice from the point of view of a French engineer. Ills. Serial, 1st part. 4000 w. Génie Civil—June 5, 1909. No. 6546 D.

Grain Elevators.

The Mt. Clare Grain Elevator, Baltimore. Illustrated description of a reinforced-concrete elevator divided into small bins which are leased. 2500 w. Eng Rec—July 3, 1909. No. 6172.

Hydraulic Filling.

Hydraulic Filling in Mining and Construction on Land and in Water (Das Spülverfahren im Berg-, Erd- und Wasserbau). Jul. Fiedler. Illustrated outline of various applications. 3300 w. Oest Wochenschr f d Oeffent Baudienst—June 12, 1909. No. 6599 D.

Reinforced Concrete.

An analysis of the Reinforced-Concrete T-Beam. Edward Godfrey. A criticism of the analytical methods commonly employed. 1200 w. Ind Engng—July 15, 1909. No. 6679 C.

Experience with Siegwart Beams (Ausführungen mit Siegwartbalken). F. Steiner. Describes and discusses mathematically the construction of the Olten electric station. Ills. 2700 w. Beton u Eisen.—June 10, 1909. No. 6706 F.

The Design of Rectangular Slabs Supported on All Sides (Beitrag zur Berechnung der rechteckigen, ringsum aufliegenden Platten). Jovo Simic. Mathematical. Ills. 2500 w. Oest Wochenschr f d Oeffent Baudienst—June 5, 1909. No. 6598 D.

Stresses and Strains in Reinforced-Concrete Subjected to Simple or Compound Bending (Tensioni e Deformazioni reali nelle Strutture di Cemento armato soggette a Flessione semplice o composta). C. Parvopassu. Mathematical. Ills. Serial, 1st part. 4000 w. Ann d Soc d Ing e d Arch Ital—June 1, 1909. No. 6552 F.

Engine House with Separately Molded Roof Members. Illustrates and describes details of interest in the construction of an engine house at Waterbury, Conn. 2500 w. Eng Rec—July 10, 1909. No. 6252.

The Mount Carmel Wing of the Chateau Frontenac, Quebec. H. P. Borden. Illustrated description of an extension increasing the capacity of this famous hotel 50 per cent. Reinforced-concrete construction is largely used. 3500 w. Eng Rec—July 24, 1909. No. 6648.

Reinforced-Concrete Construction in the Extension of the Ludwig-Maximilion University, Munich (Die Eisenbetonkonstruktionen bei dem Erweiterungsbau der Kgl. Ludwig-Maximilians-Universität München). J. Bosch. Describes many interesting features. Ills. Serial, 1st part. 1000 w. Beton u Eisen—June 10, 1909. No. 6707 F.

See also Factories and Grain Elevators, under CONSTRUCTION; and Torpedo Testing, under MARINE AND NAVAL ENGINEERING.

Retaining Walls.

Retaining Walls for Sloping Ground (Gli Speroni in Muratura per Sostegno delle Terre nelle Scarpate). Lorenzo Caracciolo. Mathematical discussion of their design. Ills. 3500 w. Ing Ferro—June 15, 1909. No. 6557 D.

Stacks.

Design of Steel Draft Stacks. Birger F. Burman. Directions for calculating stresses, and different resultant forces. Ills. 3300 w. Eng Rec—July 17, 1909. No. 6402.

Steel.

The Boston Safe Deposit & Trust Company's Building. Illustrated detailed description of a steel-cage building, 10-stories above the curb. 2500 w. Eng Rec—July 3, 1909. No. 6177.

The Denver Stock Pavilion. Illustrated description of a one-story steel building unobstructed by columns, and surrounded on all sides by inclined tiers of seats. 900 w. Eng Rec—July 17, 1909. No. 6401.

Tunnels.

Practical Test of a Tunnel Boring Machine. John Tyssowski. Illustrates and describes the machine and its work in excavating a drain tunnel near 46th St., New York City. 1000 w. Eng & Min Jour—June 26, 1909. No. 6012.

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The Rotherhithe Tunnel. Edward Henry Tabor. Illustrated description of the construction of this tunnel under the Thames. Also discussion. 27500 w. Inst of Civ Engrs, No. 3743—Dec. 8, 1908. No. 6448 N.

Bridge and Tunnel Projects for Crossing the Harbor of Sydney, New South Wales. An illustrated description of the projects for furnishing direct communication across the harbor. Also editorial on the relative merits of bridges and tunnels for river crossings. 3500 w. Eng News—July 29, 1909. No. 6774.

The Loetschberg Tunnel. H. Prime Kieffer. Illustrated description of the construction of this tunnel under the Bernese Alps. 2500 w. R. R. Age Gaz—July 2, 1909. No. 6127.

Building the Simplon Tunnel (Der Bau des Simplontunnels). Konrad Pressel. A review and detailed description of the work. Ills. Serial, 1st part. 2000 w. Zeitschr d Oest Ing u Arch Ver—June 11, 1909. No. 6594 D.

See also Sewers, under MUNICIPAL; and Tunnels, under RAILWAY ENGINEERING, PERMANENT WAY AND BUILDINGS.

Underpinning.

Underpinning a Leaning Chimney with Concrete Caissons. Ogden Merrill. Illustrated description of methods used in Jersey City, N. J. 1000 w. Eng News—July 1, 1909. No. 6086.

MATERIALS OF CONSTRUCTION.

Cement.

The Setting of Portland Cement and Its Regulation. Reviews a recent paper by H. K. G. Bamber before the Concrete Institute of Great Britain. 4500 w. Eng Rec—June 26, 1909. No. 5997.

Determination of the Effect of Age and Exposure upon the Tensile Strength of Portland Cement Before Use. Charles C. Phelps, Gilbert C. Ridgway, Edward A. Ward, and Bigelow Watts. From a graduation thesis. Report of tests. Ills. 5000 w. Stevens Ind—April, 1909. No. 6629 D.

Disintegration of Fresh Cement Floor Surfaces by the Action of Smoke Gases at Low Temperatures. Alfred H. White. Read before the Am. Soc. for Test. Mat. Gives data as to manner of laying the floors, and the investigations made. 1300 w. Engng-Con—July 14, 1909. No. 6330.

Concrete.

Influence of Storing Gauged Cement Mortar or Concrete Upon Its Capacity for Hardening. H. Burchartz. Results of comparative tests. 800 w. Cement Age—July, 1909. No. 6443.

Fireproof.

Comparative Fire Tests of Various Building Materials; Brick, Concrete, Clay, Tile and Stone. Condensed from Bul. 370, U. S. Geol. Survey, by Richard L. Humphrey. 13500 w. Engng-Con—July 14, 1909. No. 6332.

The Fire-Resistive Properties of Various Building Materials. Richard L. Humphrey. Explains the character of investigations made, the materials tested, apparatus used, methods of conducting tests, and the results. Ills. 28000 w. U S Geol Surv—Bul. 370. No. 6454 N.

Mortars.

The Decomposition of Mortars by Waters Containing Sulphates (Experiences sur la Décomposition des Mortiers par les Eaux sulfatées). J. Bied. Read before the Congress of Applied Chemistry. Results of investigations. Ills. 7500 w. Rev. de Métal—June, 1909. No. 6514 E + F.

Paints.

Waterproof and Fireproof Paints (Peintures sous-marines et Peintures ignifuges). Ch. Coffinier. Read before the Congress of Applied Chemistry. Discusses the materials available, particularly for marine work. 2200 w. Rev de Métal—June, 1909. No. 6512 E + F.

Reinforced Concrete.

Tests of Bond of Steel Bars Embedded in Concrete. H. C. Berry. Read before the Am. Soc. for Test. Mat. Describes tests made by various methods and results. 2000 w. Eng Rec—July 24, 1909. No. 6646.

Tests of Plain and Reinforced Concrete Columns. M. O. Whitney. Read before the Am. Soc. for Test. Met. Illustrated report of tests made in the laboratory at the Univ. of Wisconsin during the past year. 3500 w. Eng Rec—July 10, 1909. No. 6254.

Compression Tests of Concrete Reinforced by Nails. Leon S. Moisseiff. Abstract of a paper before the Am. Soc. for Test. Met. Explains the practical need of this material and the results of investigations. 1500 w. Engng-Con—July 14, 1909. No. 6329.

The Ability of Reinforced Concrete to Sustain Great Elongations. A communication by M. Considere to the French Academy of Sciences, translated from No. 5 of its *Comptes Rendus*. Experimental investigations. 1200 w. Cement—July, 1909. No. 6741 C.

Steel.

The Condition of the Steel Work in a San Francisco Building Erected 13 Years Ago. Frank B. Gilbreth. Reports the conditions of steel work in the Mutual Life Insurance Co.'s building after being subject to earthquake and fire, and the conclusions drawn. 1500 w. Cement—June, 1909. No. 6376 C.

Tests of the Stability of Steel Construction (Zweiter Bericht über Festig-

We supply copies of these articles. See page 1048.

keitsversuche mit Eisenkonstruktionen). Report of the Testing Committee of the German Steel Contractors' Assn., on the strength of rivetted joints. Ills. 5000 w. Zeitschr d Ver Deutscher Ing—June 26, 1909. No. 6731 D.

Steel Specifications.

New Specifications for Shapes, Plates and Rails. Gives the changes recommended by committee A of the American Society for Testing Materials. 4500 w. Ir Age—July 1, 1909. No. 6063.

Timber.

Crushing Tests on Water-Soaked Timbers. Edward C. Sherman. Brief report of tests. 500 w. Eng News—July 1, 1909. No. 6088.

Specifying and Inspecting Lumber. From comment by W. F. Goltra, on the paper read by J. M. McCarthy before the Ry. Storekeepers' Assn. Urges the adoption of the standard rules of the manufacturers, and inspection at the mill or shipping point. 1000 w. R. R. Age Gaz—July 23, 1909. No. 6632.

MEASUREMENT.

Cement Testing.

Portland Cement: The Le Chatelier Test for Soundness. Arthur Charles Davis. Reports results of tests on the expansion of cements and conclusions. 2500 w. Inst of Civ Engrs—No. 3777. No. 6451 N.

Testing Machines.

A 5000-Ton Testing Machine. Illustrated description of the large testing machine being built for the laboratories of the United States Geological Survey. 1500 w. Sci Am—July 10, 1909. No. 6210.

Principal Features of a 1,200,000 lbs. Capacity Testing Machine. Thorsten Y. Olsen. Read before the Am. Soc. for Test. Mat. An illustrated description, with special reference to a new system of transmitting the pressure developed in an hydraulic cylinder to the scale beam. 2000 w. Ir Trd Rev—July 29, 1909. No. 6776.

MUNICIPAL.

City Building.

Building an Industrial City. Illustrated description of the development of the residence portion of Gary, Indiana; the public utilities problems and how they were handled. 2000 w. Ir Age—July 1, 1909. No. 6059.

City Planning.

The Future Prince Rupert as Conceived by the Landscape Architects. George D. Hall. Plans and illustrated description of the Pacific terminal city of the Grand Trunk Pacific Railway, as designed. 3000 w. Archt Rec—Aug., 1909. No. 6754 C.

Drainage.

Drainage Interceptor Traps and Ventilation. S. E. Burgess. Paper and discussion before the Inst. of Co. & Munic. Engrs. An explanation of the author's views and practice. 5500 w. Surveyor—July 2, 1909. No. 6297 A.

See also Canals, under WATERWAYS AND HARBORS.

Pavements.

Notes on Wood Block Paving. Malcolm B. Bennett. Considers details of construction. 3500 w. Surveyor—July 16, 1909. No. 6664 A.

The Petrolithic Pavement. D. Lee Wardroper. Describes this system of road construction and the use of the roller tamper. 1800 w. Eng News—July 29, 1909. No. 6773.

Public Baths.

New Municipal Bath at Milan (Nuovo Bagno municipale a Milano al Ponte delle Gabelle). Describes a large modern installation. Ills. 3000 w. Monit Tech—June 30, 1909. No. 6553 D.

Refuse Disposal.

The New Garbage Reduction Plant at St. Louis. Very extensive works to handle the entire garbage output of the city, and to reclaim by-products, are illustrated and described. 4000 w. Eng Rec—July 3, 1909. No. 6176.

Roads.

Highway Engineering in Schools and Colleges. Logan Wallace Page. Read before the Soc. for the Pro. of Engng. Ed. Suggestions for instruction in building and maintenance of roads. 1800 w. Engng-Con—July 21, 1909. No. 6610.

Unnecessary Width of Country Roads and City Streets. Editorial discussion called forth by report of Robert J. Thompson concerning German practice. 1500 w. Eng News—July, 1909. No. 6620.

The Examination of Bituminous Materials for Road Construction. From a paper by Clifford Richardson and C. N. Forrest, before the Am. Soc. for Test. Mat. Describes methods in use in the N. Y. testing laboratory. 2000 w. Eng Rec—July 10, 1909. No. 6258.

The Effect of Free Carbon in Tars from the Standpoint of Road Treatment. Prevost Hubbard. Read before the Am. Soc. for Test. Mat. A report of investigations made to determine the effect. 4500 w. Engng-Con—July 14, 1909. No. 6331.

Methods of Constructing Roads Over Soft Ground. Explains methods employed to secure good foundations for roads crossing bogs, swamps, etc. 3000 w. Engng-Con—June 30, 1909. No. 6117.

Asphalt Macadam Roadways. Clifford Richardson. Read at road congress at

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Yukon-Alaska-Pacific Ex. Reviews experience in road construction and considers the essentials for success in the use of the materials named. 1300 w. Eng Rec—July 17, 1909. No. 6400.

An "Accelerated Test" of Road Wear by Automobile Traffic. Illustrated report of the effect of heavy motor-bus traffic on a paved highway in Germany. Also editorial. 2000 w. Eng News—July 8, 1909. No. 6227.

Roads for Automobile Traffic (Die Anpassung der Strassen an die Automobile). Alfred Ritter Weber von Ebenhof. A review of the discussion at the Paris road congress. Ills. 8300 w. Oest Wochenschr f d Oeffent Baudienst—June 26, 1909. No. 6701 D.

Sanitation.

State Health Laws and the Engineer. F. Herbert Snow. On the state regulation of water-works systems and drainage systems. 2000 w. Pro Engrs' Club of Phila—Jan., 1909. No. 6362 D.

Disinfection of a Large Dairy Premises and Many Employees After Scarlet Fever. Charles E. North. Describes how the work was carried out. 2000 w. Eng News—July 22, 1909. No. 6621.

Sewage Disposal.

Modern Aspects of Sewage Disposal and Sewerage Problems. T. Aird Murray. Read before the Saskatchewan Med. Assn. Discusses various systems and their value. 6500 w. Can Engr—July 16, 1909. No. 6377.

Discussion on Topics Connected With Sewage Disposal. 8000 w. Pro Engrs' Club of Phila—Jan., 1909. No. 6363 D.

Some Notes on the Tank Treatment of Sewage, Based on the Fifth Report of the Royal Commission. A. P. I. Cotterell. Considers the subject from an engineering point of view. Discussion. 4000 w. Surveyor—June 18, 1909. No. 6032 A.

Sewage Purification Works Visited in Europe. George S. Webster. Describes interesting features observed. 3500 w. Pro Engrs' Club of Phila—Jan., 1909. No. 6361 D.

Sewage Testing.

Sewage Testing Station for the City of Philadelphia. Illustrated description of details of the equipment and work of investigation, with a view of determining the processes best adapted to secure desired results. 2500 w. Eng Rec—July 17, 1909. No. 6399.

Sewers.

Sea Outfall-Sewers. Ben Howorth. Considers the requirements of such sewers, and describes outfall-sewers on the British Coasts. 5000 w. Inst of Civ Engrs (Students' paper No. 615.)—Feb. 13, 1908. No. 6453 N.

Sewer Tunnelling. Alfred E. Snape. Read before the Inst. of Co. and Munic. Engrs. Describes methods used in actual practice. Ills. 6000 w. Surveyor—July 9, 1909. Serial, 1st part. No. 6415 A.

Stone Crushing.

New Stone-Crushing Plant of the Dolese & Shepard Company. Illustrated description of the plant at Gary, Ill., and its operation. 3500 w. Eng Rec—July 24, 1909. Serial, 1st part. No. 6650.

Street Records.

Method of Keeping Data Relating to Street Lines and Grades. H. A. Varney. Explains the method used by the town of Brookline, Mass. 900 w. Eng News—July 8, 1909. No. 6225.

WATER SUPPLY.

Artesian Wells.

Conservation of Our Artesian Water-Supply. Frederick G. Clapp. Considers the amount of underground water, its uses, causes of decline, &c. 5000 w. Eng News—July 15, 1909. No. 6384.

Ashokan.

The New Water Supply of New York City. H. Prime Kieffer. Describes the Ashokan water system, now under construction. Ills. 3000 w. Munic Engng—July, 1909. Serial, 1st part. No. 6444 C.

Civil-Service Law.

Civil Service in Its Application to the Water Department. Joseph C. Pelletier. An explanation of the Civil Service law as applied to this service. Discussion. 5500 w. Jour N Eng W-Wks Assn—June, 1909. No. 6464 F.

Cofferdams.

See Concrete, under CONSTRUCTION.

Dams.

Some Observations on the Stability of Dams. J. F. Jackson. Presented to the W. Soc. of Engrs. Discusses the manner of calculating and constructing the various generally accepted types. Diagrams. General discussion. 2500 w. Eng News—July 29, 1909. No. 6771.

The Slide in the Necaxa Hydraulic-Fill Dam. Notes by James D. Schuyler on the design of the dam and its failure. Ills. Also editorial. 3500 w. Eng News—July 15, 1909. No. 6385.

Hydraulic-Fill Dams and the Necaxa Accident. Editorial on the recent slip of a portion of this dam near the City of Mexico, and the lesson it should teach. 1500 w. Eng Rec—July 3, 1909. No. 6171.

The Designs for Emergency Movable Dams for the Panama Canal. Drawings and description of the present accepted designs explaining the method of operation. 3500 w. Eng News—July 22, 1909. No. 6619.

See also Concrete, under CONSTRUCTION.

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Distribution.

The Distribution of the Waters of the Mology (La Distribution des Eaux du Mology). K. A. Breuer. Describes novel features in connection with the works for utilizing the waters of this small Swiss river. Ills. Serial, 1st part. 2300 w. Bul Tech d l Suisse Romande—June 25, 1909. No. 6541 D.

Filtration.

The Cost of Four Slow Sand Filter Plants and Cost of Operation. 4500 w. Engng-Con—July 7, 1909. No. 6205.

Water Filters of Providence, R. I. Illustrated description of the construction of slow sand filters for the purification of the water supply. 2500 w. Munic. Jour & Engr—July 21, 1909. No. 6455.

Government Control.

See Sanitation, under MUNICIPAL.

Intakes.

The Intake of the Water Works at Algiers, Louisiana. Illustrated description of an intake designed specially to meet difficult local conditions. 1500 w. Eng Rec—July 3, 1909. No. 6175.

Water Intake for the Jones & Laughlin Steel Company. Francis Donaldson. Illustrated description of work in connection with the new Aliquippa plant on the Ohio River. 1600 w. Eng Rec—July 17, 1909. No. 6397.

Pipe Electrolysis.

Lead-Covered Cables a Cause of Electrolysis Upon Water and Gas Pipes. A. A. Knudson. Discusses electrolysis caused by bonding the lead sheaths to the railway return, examining methods of construction. Ills. 4000 w. Jour N Eng W-Wks Assn—June, 1909. No. 6461 F.

Pipe Flow.

The Flow of Water in Pipes, Culverts, and Channels. Ernest H. Essex. Read before the Inst. of Co. & Munic. Engrs. A comparison of different formulæ in use, and a record of recent tests. 3000 w. Surveyor—July 16, 1909. No. 6663 A.

Reservoirs.

A Huge Filtered Water Reservoir for London. Illustrations, with short description. 1000 w. Sci Am—July 3, 1909. No. 6090.

Covered Reservoirs. Frank L. Fuller. Gives experience in the use of concrete in their construction and in making them watertight. 1800 w. Jour N Eng W-Wks Assn—June, 1909. No. 6463 F.

Two Accidents to Reinforced Concrete Reservoirs. An illustrated account of accidents to reservoirs at Guthrie, and Oklahoma City, and the method of repairing. 1000 w. Eng Rec—June 26, 1909. No. 5998.

Run-off.

Yield of Water, Rainfall, Etc., on a Moorland Watershed. S. Hutton. Abstract of paper read before the Inc. Assn. of Munic. & Co. Engrs. Gives results obtained and particulars relating to two watersheds. 1000 w. Engr, Lond—July 16, 1909. No. 6693 A.

Stream Gauging.

Measurement of Water Speed with the Pitot Tube (Ueber die Messung von Wassergeschwindigkeiten mit der Pitotschen Röhre). K. Ellon. Describes the device and its theory. Ills. 2800 w. Zeitschr d ver Deutscher Ing—June 19, 1909. No. 6728 D.

Water Lift.

Supplying a High-Level Reservoir by the Discharge of a Reservoir at a Lower Level (Alimentation d'un Réservoir surélevé par la Conduite de Refoulement d'un Réservoir inferieur). P. Aristide Bergès. Describes an arrangement by which water is raised by the energy in water at a lower level but without loss. Ills. 2000 w. Génie Civil—June 26, 1909. No. 6550 D.

Water Works.

The Water Works of West Springfield, Massachusetts. Brief description with plan and sections. 1500 w. Eng Rec—July 10, 1909. No. 6259.

Notes on Newton, N. J., Water Works Construction and Litigation. Louis L. Tribus. Illustrated detailed description of the plant, and account of suits for damages. Discussion. 6000 w. Jour N Eng W-Wks Assn—June, 1909. No. 6460 F.

Water-Works Valuation.

Water-Works Appraisements in Missouri and Kansas. Clinton S. Burns. A brief description of nine appraisements made for municipalities. 2200 w. Eng News—July 29, 1909. No. 6769.

Weirs.

The Flow of Water Over Oblique Weir Plates. Results of experiments, by Dr. O. G. Aichel, on the discharge of water over weir plates oblique to the axis of the flowing stream. 1500 w. Eng Rec—July 3, 1909. No. 6174.

WATERWAYS AND HARBORS.

Antwerp.

The New Harbor Works at Antwerp (Die neuen Hafenanlagen von Antwerpen). W. Kaemmerer. Illustrated description of a sea wall, a new lock, and other works. 3300 w. Zeitschr d Ver Deutscher Ing—June 5, 1909. No. 6720 D.

Barge Canal.

The Excavating and Dredging Outfit on the Oneida River Section, Contract No. 12, of the New York State Barge Canal. Extract from the Barge Canal March Bulletin, 1909. Describes the conditions and the equipment for carrying out the work. 4000 w.—Eng News—July 29, 1909. No. 6768.

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Breakwaters.

See Sea Walls, under WATERWAYS AND HARBORS.

Canals.

The Cape Cod Ship Canal. Brief illustrated account of this canal now under construction, between Barnstable Bay and Buzzard's Bay. 1500 w. Eng. Rec—July 24, 1909. No. 6645.

The Sanitary District of Chicago, and the Chicago Drainage Canal: A Review of 20 Years of Engineering Work. Isham Randolph. With colored map, profile, and cross-sections. 9000 w. Eng News—July 22, 1909. No. 6618.

Dredging.

See Rangoon, under WATERWAYS AND HARBORS; and Dredges, under MARINE AND NAVAL ENGINEERING.

Flood Protection.

Flood Protection in the Kansas River Valley at Kansas City. J. Y. Olesen. Gives recommendations for flood protection, taken from the Army Engr's report, and H. N. Pharr's report. 3000 w. Eng News—July 15, 1909. No. 6387.

France.

French Commercial Harbors (Nos Ports de Commerce). C. Boutillier. A discussion of their condition, improvements necessary and the means whereby they can be realized. 7000 w. Tech Mod—June, 1909. No. 6537 D.

Lock Gates.

An Attempt to Destroy Canal Lock-Gates by Dynamite. An account of an attempt made in 1900 to injure gates on the Welland Canal. 700 w. Eng News—July 1, 1909. No. 6083.

Hydraulically Operated Lock Gates at Meppen, Dortmund-Ems Canal (Commande Hydraulique des Portes l'Ecluse de Meppen, Canal de Dortmund à l'Ems). Illustrated description. 2000 w. Génie Civil—June 26, 1909. No. 6551 D.

Locks.

Accident at Sault Ste. Marie. Illustrated description of the recent accident in which the lock gates were carried away. 1500 w. Marine Rev—July, 1909. No. 6322.

The Accident on the Sault Ste. Marie Canal. Editorial on the recent accident which carried away the lock-gates of the Canadian Canal. 2000 w. Engng—July 9, 1909. No. 6425 A.

The Lessons of the Soo Lock Accident. Editorial discussion of the cause of the accident, and its effect upon the judgment as to the Panama Canal. 2000 w. Eng Rec—June 26, 1909. No. 5995.

The Locks of the Panama Canal. An illustrated article reporting the progress of lock excavation and describing the lock structures. 5000 w. Eng News—July 15, 1909. No. 6382.

Constructing the Concrete Locks of the Panama Canal. H. Prime Kieffer. Illustrates and describes the methods of construction and the material-handling plants. 2000 w. Sci Am—July 17, 1909. No. 6334.

Mechanical Ship-Lifts (Ueber Schiffshebewerke mit Schraubenführung). Fr. Jebens. Describes lift locks operated by screws. Ills. 2000 w. Deutsche Bau—June 12, 1909. No. 6576 B.

Panama Canal.

A Sea-Level Canal at Panama—A Study of Its Desirability and Feasibility. Discussion of Henry G. Granger's paper on this subject. 17500 w. Bul Am Inst of Min Engrs—July, 1909. No. 6476 F.

The Panama Canal. J. F. Springer. An illustrated account of the work in progress, the machinery used, and the construction details. 5000 w. Ir Age—July 1, 1909. Serial, 1st part. No. 6060.

The Panama, a Machine Made Canal. Illustrates and describes machines being used, comparing the results with hand labor. 4000 w. Am Mach—Vol 32. No. 28. No. 6325.

Construction of the Obispo Diversion in Connection with the Panama Canal Work. Illustrated description of the work, with topographical map and profile. 3000 w. Eng Rec—June 26, 1909. No. 5996.

See Also Contractors' Plants, under CONSTRUCTION; Dams, under WATER SUPPLY; and Locks, under WATERWAYS AND HARBORS.

Piers.

New San Francisco Shipping Piers, with Concrete Cylinder Foundations and Fireproof Deck and Superstructure. John G. Little. Illustrated description. 2000 w. Eng News—July 8, 1909. No. 6229.

Pollution.

The Present Problem as to the Pollution of Lake Michigan. Editorial on the present condition and the proper remedy. 1600 w. Eng News—July 15, 1909. No. 6386.

Rangoon.

New Port Works at Rangoon. Illustrates and describes extensive improvements in progress, and special features in the design of the dredger pipe line. 2000 w. Engr, Lond—July 16, 1909. Serial, 1st part. No. 6691 A.

Rhone.

The Navigability of the Rhone (La Navigabilité du Rhone). Pierre Clerget. A discussion of geographical conditions, regulation problems and economic considerations. 5800 w. Rev. Gen des Sci—June 30, 1909. No. 6530 D.

Ruhrort.

The Duisburg-Ruhrort Harbor (Vom Ausbau des Hafens zu Duisberg-Ruhrort).

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Describes various parts of the works. Ills. Serial, 1st part. 2000 w. Deutsche Bau—June 19, 1909. No. 6577 B.

Seattle.

The Harbor at Seattle, Washington. H. Cole Estep. The second of a series of articles describing the principal harbors of the Pacific coast. Ills. 4000 w. Marine Rev—July, 1909. No. 6323.

Sea Walls.

Sea Walls and Breakwaters. James Hill Forman. Deals principally with conditions in Great Britain. 4500 w. Inst of Civ Engrs (student's paper No. 607)—Dec. 23, 1907. No. 6452 N.

Saved by Its Wonderful Concrete Sea Wall. Albert Phenis. An account of the way the Galveston sea wall endured a recent severe storm. 3000 w. Mfrs Rec—July 29, 1909. No. 6755.

U. S. Waterways.

The Fourteen-Foot Channel from St. Louis to the Gulf. A full abstract of the report of the Mississippi River improvement board. Information on the cost and usefulness of a deep waterway from Chicago to the Gulf of Mexico, adverse to the project. 3500 w. Eng Rec—June 26, 1909. Serial, 1st part. No. 6003.

Wharves.

The Paris-Austerlitz Wharf and Public Sheds (Port et Magasins publics de Paris-Austerlitz). Ch. Dantin. Illustrated description of a covered wharf on the Seine at Paris. 5000 w. Génie Civil—June 26, 1909. No. 6549 D.

MISCELLANY.

Forestry.

Some Problems of Forestry. Leslie B. Seely. Considers the economic side of the problem, showing results achieved in European countries; discusses the influence of forests on precipitation and drainage. 6000 w. Jour Fr Inst—July, 1909. No. 6352 D.

ELECTRICAL ENGINEERING.

COMMUNICATION.

Radiotelegraphy.

The Theory of Coupled Circuits. Louis Cohen. A mathematical paper developing a method of solving the problems, and yet avoiding the difficulty of getting the roots of a biquadratic equation. These coupled circuits are used to increase the energy for radiation in wireless telegraphy. 4000 w. Bul Bureau of Stand—May, 1909. No. 6371 N.

The Lepel Wireless Telegraph System. Baron von Lepel. Aims to show that Count Arco's telefunken system is an intentional copy of the von Lepel system. Also an experimental investigation of the latter system, made by J. Erskine-Murray. 3500 w. Elect'n, Lond—June 18, 1909. No. 6030 A.

Telegraph Wires.

Testing and Care of Wires. V. T. Kissenger. From a paper read before the Ry Telegraph Supts. Assn. General directions. 700 w. R. R. Age Gaz—July 30, 1909. No. 6783.

Telephone Cables.

The Modern Telephone Cable. Frank B. Jewett. Considers the essential requirements and how nearly the present dry-core cable meets them. 5000 w. Pro Am Inst of Elec Engrs—July, 1909. No. 6495 F.

Telephony.

New Telephone Installations in Paris (Nouvelles Installations Téléphoniques de Paris). H. E. A. André. Describes interesting features of practice, apparatus, installations, etc. Ills. 2100 w. Bul Soc Int d Elecns—June, 1909. No. 6505 F.

Telephotography.

A New System of Electric Telephotography and Its Possibilities for the Electrical Transmission of Living Pictures (Ein neues System der elektrischen Fernphotographie und die aus demselben sich ergebenden Aussichten der Uebertragung hebender Bilder auf elektrischem Wege). Robert Schönhofer. Illustrated description. 2000 w. Elektrotechniker—June 25, 1909. No. 6708 D.

DISTRIBUTION.

Fuses.

Some Considerations in Designing Heavy Capacity Fuses. Louis W. Downes. Considers the subject theoretically, giving calibration tests supporting some of the deductions, and explains the actual operation of the fuse under short-circuit. 4000 w. Pro Am Inst of Elec Engrs—July, 1909. No. 6494 F.

Motor Circuits.

Supply Circuits for Electric Motors. Cecil P. Poole. Gives a method of finding the correct size of wire, or the loss in a motor circuit. 3500 w. Power—July 27, 1909. No. 6740.

DYNAMOS AND MOTORS.

A. C. Dynamos.

Electromotive Force Wave-Shape in Alternators. Comfort A. Adams. An application of the methods of connecting the shape of the flux-distribution curve with the e. m. f. wave shape, developed

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by the writer, with an illustration taken from Mr. Bache Wiigs paper. 3500 w. Pro Am Inst of Elec Engrs—July, 1909. No. 6488 F.

A Method of Compounding Alternators by Means of Condensers. W. Linke. Trans from *Elektrotechwirsche Zeit.* Describes interesting tests on a small machine. 600 w. Elec Engr, Lond—July 2, 1909. No. 6292 A.

A. C. Motors.

Improvement of Power-Factor and Commutation Conditions in Single-Phase Series Motors. A. S. McAllister. Discusses methods of overcoming disadvantageous conditions with reference to the low power-factor and sparking. 5000 w. Jour Fr Inst—July, 1909. No. 6354 D.

Three-Phase Device for Driving Phonograph and Moving-Picture Machines. Francis M. Weldon. Illustrated description of a device for operating a phonograph and moving-picture machine in order to produce the image and sounds at the same time. 1200 w. Elec Wld—July 29, 1909. No. 6762.

A. C. Turbo-Generators.

Turbo-Generators (Turbodynamos und Turboelektromotoren). F. Niethammer. Describes and discusses the leading types of alternating-current machines. Ills. Serial, 1st part. 7200 w. Zeitschr d Ver Deutscher Ing—June 26, 1909. No. 6730 D.

Armatures.

Alternator Armature Windings. Edgar Knowlton. Gives methods of determining the correctness of armature connections, principally when the connections are unsymmetrical. 700 w. Elec Wld—July 1, 1909. No. 6107.

Controllers.

Automatic Motor Control. H. E. White. Explains the methods by which the results are attained. 2000 w. Pro Am Inst of Elec Engrs—July, 1909. No. 6499 F.

Special Motor-Controlling Devices in the Rolling Mill of the Indiana Steel Company, Gary, Ind. Illustrated description. 1500 w. Elec Wld—July 8, 1909. No. 5222.

Induction Motors.

A Sketch of the Theory of the Adjustable-Speed, Single-Phase, Shunt Induction Motor. F. Creedy. Discusses the variation of the speed of these machines from synchronism. 7500 w. Pro Am Inst of Elec Engrs—July, 1909. No. 6490 F.

The Current Locus of the Single-Phase Induction Motor. A. S. Langsdorf. Mathematical treatment giving experimental results. 1500 w. Pro Am Inst of Elec Engrs—July, 1909. No. 6484 F.

Multispeed Induction Motors. H. G. Reist and H. Maxwell. The methods of varying the speed are briefly considered and the design and selection of types discussed. 2000 w. Pro Am Inst of Elec Engrs—July, 1909. No. 6497 F.

Induction Motor Characteristics and Their Relation to Its Application. J. W. Rogers. An illustrated article discussing the choice of motors for the operation of machinery. 4000 w. Cassier's Mag—July, 1909. No. 6347 B.

Speed Control of Induction Motors by Cascade Connection. H. C. Specht. Describes different schemes for possible speed combinations in a cascade set and considers the performances. 2500 w. Elec Jour—July, 1909. No. 6438.

Railway Motors.

The Speed of Railway Motors (Ueber die Bemessung der Umdrehungszahl bei elektrischen Bahnmotoren). W. Kummer. A mathematical discussion of motor design to give a certain speed under specified load conditions. Ills. 3500 w. Schweiz Bau—June 12, 1909. No. 6579 B.

Reactance Coils.

The Use of Reactance Coils in Generating Stations. P. Junkerfeld. Read before the N. E. L. A. Discusses the advisability of using reactance coils for protection of generators. Also editorial. 4500 w. Elec Age—June, 1909. No. 6129.

Practical Design of Reactance Coils for Turbo-Generators. A. S. Loizeaux. Read before the N. E. L. A. Information in regard to designing, testing and operating. Ills. 2500 w. Elec Age—June, 1909. No. 6130.

Rheostats.

Rheostats for Series Machines (Reóstatos para Máquinas serie). Ricardo Caro. Mathematical discussion. Serial, 1st part. 2000 w. Energia Elec—June 10, 1909. No. 6558 D.

Windings.

Application of Shortened-Pitch Windings (Die Verwendung des verkürzten Wickelschrittes). F. Punga. Discusses their application to d. c. and three-phase generators and motors and to single-phase commutator motors. Ills. 3000 w. Elektrotech u Maschinenbau—June 13, 1909. No. 6715 D.

ELECTRO-CHEMISTRY.

Cells.

Characteristics of Dry Cells. F. H. Loveridge. Read before convention of the Supts. of Telegraphs. Gives some of their characteristics and indicates what classes of service they are adapted to meet, and precautions necessary for their practical working. 3500 w. Sig Engr—July, 1909. No. 6435.

Three Years' Practice of the Townsend Cell. L. H. Baekeland. Read before the Int. Cong. of Ap. Chem., in

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London. Report from data gathered at the Niagara plant. 2500 w. Elec-Chem & Met Ind—July, 1909. No. 6193 C.

Detinning.

The Detinning Industry in Italy (L'Industria della Distagnatura e le sue Condizioni in Italia). Mario Lombardi. Describes methods, plants, etc. 3500 w. Industria—June 13, 1909. No. 6554 D.

Electroplating.

Making Up Small Electroplating Solutions, Particularly Those of Gold, by the Use of a Porous Cup. Illustrated description of a process suited for making up small solutions. 2000 w. Brass Wld—July, 1909. No. 6477.

Nitrogen.

The Fixation of Atmospheric Nitrogen. Sam Eyde. Illustrated description of the Birkeland-Eyde process. 3500 w. Sci Am Sup—July 3, 1909. No. 6091.

The Manufacture of Saltpeter from the Air by the Process of the Badische Anilin & Soda Fabrik. A general description of the process. 2000 w. Elec Rev, N. Y.—June 26, 1909. No. 6017.

ELECTRO-PHYSICS.

Alternating Currents.

Even Harmonics in Alternating-Current Circuits. John B. Taylor. A discussion of usual and special conditions giving rise to even harmonics in alternating-current circuits. Ills. 1500 w. Pro Am Inst of Elec Engrs—July, 1909. No. 6496 F.

Electric Waves.

Distorted Waves and Their Analysis by a Simple Method. Henry Hermann. Outlines the method and analysis of typical waves. 5000 w. Elec Rev, N Y—July 17, 1909. No. 6394.

Experimental Method for the Analysis of E. M. F. Waves. P. G. Agnew. Describes experiments made to determine whether it is possible to get an approximate value of the first and second harmonics present in an e. m. f. wave by means of ordinary portable instruments and calibrated condensers. 2500 w. Elec. Wld—July 15, 1909. No. 6336.

The Coefficient of Reflection of Electrical Waves at a Transition Point. Louis Cohen. Develops an expression for the ratios of the reflected and transmitted waves to the incoming wave at a transition point. 900 w. Bol Bureau of Stand—May, 1909. No. 6373 N.

Graphical Computation of Fourier's Constants for Alternating-Current Waves. Charles S. Slichter. Describes a method of analysis requiring the wave form to be plotted on specially prepared co-ordinate paper, once for each harmonic, and the curve to be measured by planimeter. Also editorial note. 1500 w. Elec Wld—July 15, 1909. No. 6338.

Heat Convection.

The Convection of Heat from Small Copper Wires. A. E. Kennelly, C. A. Wright and J. S. Van Bylevelt. Describes a research made on the convective loss of heat from small copper wires, of less than 0.7 mm. or 27.5 mils diameter, presenting quantitative results. Ills. 5500 w. Pro Am Inst of Elec Engrs—July 1909. No. 6483 F.

Röntgen Rays.

An Apparatus for Generating High-Tension Direct Current for the Production of Röntgen Rays (Ein Apparat zur Erzeugung hochgespannten Gleichstroms für die Röntgentechnik). Martin Hochstädter. Illustrated description. Serial, 1st part. 3200 w. Elektrotetch u Maschinenbau—June 13, 1909. No. 6716 D.

GENERATING STATIONS.

Accumulators.

The Application of Storage Batteries to the Regulation of the Alternating-Current Load at the Plant of the Indiana Steel Company, Gary, Indiana. J. Lester Woodbridge. A brief general description, giving an account of the actual commercial operation. Ills. 3000 w. Pro Am Inst of Elec Engrs—July, 1909. No. 6493 F.

See also Electric, under AUTOMOBILES.

Central Stations.

Central Stations in Towns of Less Than 4000 Population. James S. Knowlson. Abstract of a paper read before the Nat Elec Lgt Assn. Considers conditions essential to success and satisfactory service. Ills. 3500 w. Elec Rev, N. Y.—July 24, 1909. No. 6653.

Small English Central Station. Charles Dawson. Illustrated description of practice in small English towns. 1200 w. Elec Wld—July 1, 1909. No. 6104.

The Design of a Power Plant for a Street Railway for Iowa City. John Scherner. Extract from a prize thesis. Considers the location, capacity and type of plant and the selection of apparatus. 4500 w. Transit—June, 1909. No. 6481 N.

Plant of the Commonwealth Power Company Osborn Monnett. Illustrated description of a central station in Milwaukee, for supplying a group of buildings with light and power. 3000 w. Power—July 27, 1909. No. 6695.

See also Gas Engines, under MECHANICAL ENGINEERING, COMBUSTION MOTORS.

Design.

Determining the Power Requirements of a Central Station (Remarqnes sur la Détermination de la Puissance des Centrales électriques). J. F. Audouin. Discusses provision for overload capacity, etc. Ills. 2000 w. Rev Indus—June 12, 1909. No. 6544 D.

We supply copies of these articles. See page 1048.

Economics.

The Public Supply of Electric Power. G. L. Addenbrooke. Discusses the economic and technical sides of the question in the United Kingdom. 8500 w. Jour Soc of Arts—July 9, 1909. Serial, 1st part. No. 6412 A.

Hydro-Electric.

The Hoosic River Development of the Schenectady Power Company. Illustrated description of details at the Schaghticoke plant, and at the Johnsonville plant. These plants are capable of independent operation, though essentially parts of one development. 2500 w. Eng Rec—July 24, 1909. Serial, 1st part. No. 6643.

Development of Water Power at Great Falls. Alexander Leggat. Illustrated description of these falls on the Missouri River, which form one of the great water-powers of the world, and of their development. 4000 w. Min Wld—July 24, 1909. No. 6654.

The Kaaden Hydro-Electric Plant on the Eger (Das Elektrizitätswert an der Eger der Stadt Kaaden). W. Werner. Illustrated description of this important installation in Austria. Ills. 2200 w. Oest Wochenschr f d Oeffent Baudienst —June 19, 1909. No. 6700 D.

Isolated Plants.

Operating Results of an Isolated Power Plant at Binghamton, N. Y. Information concerning the plant of the Security Mutual Life Insurance Co., which has shown very good results in operation. Ills. 3000 w. Eng Rec—July 24, 1909. No. 6649.

New Turbine Power Plant of the Nairn Linoleum Company. Illustrated description of a new plant to serve a group of buildings and replace rope drives with electrical power. 2200 w. Eng Rec—July 10, 1909. No. 6255.

See also Terminals, under RAILWAY ENGINEERING, PERMANENT WAY AND BUILDINGS.

Load Curves.

Lessons from the Power Station Load Curve. H. S. Knowlton. A study of given curves, showing how to interpret them. 2200 w. Power—July 27, 1909. No. 6698.

Load Factors.

Compilation of Load Factors. E. W. Lloyd. Read before the Nat. Elec. Lgt. Assn. Information on ordinary classes of business for use of commercial men selling electrical energy for power and lighting 2500 w. Elec Rev, N Y—July 17, 1909. No. 6395.

Rates.

The Diversity Factor Amongst Lighting Consumers. Considers the estimating of the diversity factor, and the charging for lighting. 900 w. Elect'n, Lond—July 16, 1909. No. 6668 A.

Cheap Units. Alex. Sinclair. Abstract of paper and discussion before the Incor. Munic. Elec. Assn. Discusses means of determining a fair cost per unit for energy supplied to various classes of consumers. 3500 w. Elect'n, Lond—July 2, 1909. No. 6295 A.

Switchboards.

The Control Switchboards for the Power House Equipment at the Indiana Steel Company's New Gary Works. E. A. Lof. Illustrated detailed description 3500 w. Elec Rev, N Y—June 26, 1909. No. 6016.

Switchgear.

Some Elementary Considerations of High-Tension Switchgear. Notes giving suggestions helpful in selecting a suitable switch. 1700 w. Elec Engr, Lond —July 16, 1909. Serial, 1st part. No. 6667 A.

LIGHTING.

Arc Lamps.

The Regenerative Flame Lamps. A. T. Mitchell. Read before the N. E. L. A. Discusses their efficiency, explaining mechanical details. Ills. 3000 w. Elec Age—June, 1909. No. 6133.

Fire Risks.

Electric Lighting and Fire Risks. Arthur Pordage. Read at the Fire Brig. Off. Conf., London. Discusses fires due to electric currents and their causes. 1800 w. Archt, Lond—July 2, 1909. No. 6289 A.

Illumination.

Color and Visual Acuity. J. S. Dow. Also editorial notes. Discusses difficulties met in illumination problems when dealing with colored lights. 6000 w. Elec Wld—July 15, 1909. No. 6339.

Incandescent Lamps.

The Influence of Metallic Filament Lamps on the Electrical Industry and on Street Lighting. E. E. Hoadley. Abstract of a paper read before the Incor. Munic. Elec. Assn. and of the discussion. Gives figures showing results in street lighting. 2000 w. Elect'n, Lond —June 25, 1909. No. 6274 A.

Power Characteristics of the Tungsten Filament. Charles P. Steinmetz. Reports an investigation of the manner in which the power consumption increases with increase of voltage. Also editorial note. 1200 w. Elec Wld—July 8, 1909. No. 6220.

Carbon-Filament and Tungsten Lamps (Ueber Kohlenfaden- und Wolframlampen). Al. Berninger. A comparison of efficiency. Ills. 3800 w. Elektrotetch u Maschinenbau—June 27, 1909. No. 6719. D.

See also Shop Practice, under MECHANICAL ENGINEERING, MACHINE WORKS AND FOUNDRIES.

We supply copies of these articles. See page 1048.

Photometry.

Uniformity in the Photometry of Colored Light-Sources. F. E. Cady. Describes a scheme for overcoming difficulties by using standardized color screens. Also editorial. 3500 w. Elec Wld—July 22, 1909. No. 6615.

A Tungsten Comparison Lamp in the Photometry of Carbon Lamps. Herbert E. Ives and L. R. Woodhull. Experience shows the Tungsten comparison lamp to be superior for the purpose to carbon lamps. 1200 w. 6374 N.

Progress.

Progress in Electric Current Development in the Artificial Lighting Field. Albert F. Ganz. An interesting review. 8200 w. Am Gas Lgt Jour—July 19, 1909. (Section 2.) No. 6405 N.

MEASUREMENT.

Instruments.

Temperature Errors in Shunted Ammeters. W. Fennell. Discusses errors due to changes of temperature, and also other causes of error. 1400 w. Elec Rev, Lond—June 25, 1909. No. 6273 A.

Insulation Testing.

On Testing the Insulation Resistance of Live Cables on Direct-Current Systems by the Kelvin Testing Set. R. G. Allen. Abstract of paper read before the Dublin Sec. of the Inst of Elec. Engrs. Describes method. Diagrams. 800 w. Elect'n, Lond—July 16, 1909. No. 6669 A.

Laboratories.

See Education, under INDUSTRIAL ECONOMY.

Meters.

The Effects of Short-Circuits on Watt-Hour Meters. A. L. Goetz. An account of experiments made and conclusions. Ills. 1200 w. Transit—June, 1909. No. 6479 N.

A Volt Scale for a Watts-per-Candle Meter. Herbert E. Ives. Describes an efficiency-meter volt scale and its use. 1500 w. Bul Bureau of Stand—May, 1909. No. 6372 N.

Mercury Motor Continuous-Current Electricity Meters. Rankin Kennedy. A résumé of the different stages of development in this class of instrument. 1000 w. Elec Rev, Lond—June 18, 1909. No. 6029 A.

Resistance.

A New Method for the Absolute Measurement of Resistance. Edward B. Rosa. Describes a new revolving coil method, explaining its advantages. Ills. 2500 w. Bul Bureau of Stand—May, 1909. No. 6370 N.

Standard Cells.

The Standard Electrical Cell—Its Use and Its Practical Value. Herbert T. Wade. Information concerning the forms of cells used and their agreement. Ills. 1500 w. Sci Am—July 10, 1909. No. 6239.

Transformer Testing.

Method of Testing Transformer Core Losses, Giving Sine-Wave Results on Commercial Circuits. L. W. Chubb. Describes an instrument termed an iron-loss voltmeter, dealing in detail with transformer core-loss tests. Ills. 3000 w. Pro Am Inst of Elec Engrs—July, 1909. No. 6489 F.

POWER APPLICATIONS.

Hoisting.

See Electric Hoisting, under MINING AND METALLURGY, MINING.

Textile Mills.

See Electric Driving, under MECHANICAL ENGINEERING, POWER AND TRANSMISSION.

TRANSMISSION.

Cables.

The Composition and Durability of Cable Papers. C. Beaver. A statement of facts from the cable manufacturer's standpoint. Supplemental to articles by Clayton Beadle and Henry P. Stevens, from the chemist's point of view. Also ediotrial. 4500 w. Elect'n, Lond—July 9, 1909. No. 6420 A.

Heating of Underground Cables. J. R. Dick. Considers the factors causing a rise of temperature, and the consequences. Ills. 1500 w. Elect'n, Lond—June 25, 1909. No. 6276 A.

Surges on a Cable System with an Aluminum Surge Protector. E. E. F. Creighton and S. D. Sprong. Experimental investigation of the surges on an underground alternating current distribution system, and the protection by aluminum cells. 5500 w. Pro Am Inst of Elec Engrs—July, 1909. No. 6491 F.

Modern Cable Systems. E. M. Hollingsworth. Abstract of paper before the Incor. Munic. Elec. Assn. Discusses aluminum cables and considers the properties of various insulating materials for underground cables. Also methods of laying cables. 2500 w. Elect'n, Lond—June 25, 1909. No. 6275 A.

Underground Cable System in a Village of Two Thousand Inhabitants. J. Franz. Brief illustrated description of a plant at Stockbridge, Mass. 800 w. Elec Wld—July 22, 1909. No. 6613.

See also Insulation Testing, under MEASUREMENT.

Grounding.

Grounding Electric Light Wires on Water Pipes. F. E. Merrill. A brief review of a study made of grounding electric wires on the water pipes in the city of Somerville, and its results. Discussion. 7500 w. Jour N Eng W-Wks Assn—June, 1909. No. 6462 F.

We supply copies of these articles. See page 1048.

Insulators.

Researches on the Distribution of Potential at the Surface of Line Insulators (Quelques Recherches sur la Distribution du Potentiel à la Surface des Isolateurs en Ligne). G. Anfossi. Brief description, with results. Ills. 1500 w. L'Elecn—June 12, 1909. No. 6535 D.

High-Tension Insulators with Metal Mantles (Hochspannungsisolatoren mit Metalldach). W. Weicker. Describes types and their efficiency. Ills. 2000 w. Elek Kraft u Bahnen—June 4, 1909. No. 6710 D.

Line Construction.

Conditions Encountered by Towers in High-Tension Transmission Lines. N. J. Neall. Considers the limitations of various forms of support, giving an analysis of the service requirements, explaining by a typical case. 6000 w. Elec Wld—July 1, 1909. No. 6106.

River Crossing by Electrical Transmission Lines (Transports d'Energie électrique: Traversée des Fleuves). M. Déthiollaz. Describes the design of crossings for the Southern Electric Company of France. Mathematical. Ills. Serial, 1st part. 3000 w. Tech Mod—June, 1909. No. 6539 D.

Line Design.

Complete Solution of Transmission Line with Distributed Capacity and Leakage. Harold Pender. Gives formulæ for practical use, showing how they are derived. 2000 w. Elec Wld—July 8, 1909. No. 6221.

Graphical Calculation of Direct-Current Distribution Systems (Calcul graphique des Distributions électriques à Courant continu). H. Michel. Illustrates the graphical solution of a number of transmission problems. 5000 w. Soc Belge d'Elecns—June, 1909. No. 6500 E.

Lines.

The Distribution System of the Southern Electric Company of France (Réseau de Distribution d'Energie électrique de la Société du Sud électrique). J. A. Montpellier. Ills. Serial, 1st part. 1600 w. L'Elecn—June 12, 1909. No. 6536 D.

Transformers.

The Theory of Current Transformers (Zur Theorie des Stromtransformators). M. Seidner. Mathematical. Ills. 4000 w. Elektrotech u Maschinenbau—June 6, 1909. No. 6714 D.

The Testing of Transformer Steel. M. G. Lloyd and J. V. S. Fisher. Discusses the conditions that should be realized, describing a modification of the Epstein method and apparatus, giving results obtained. 6500 w. Bul Bureau of Stand—May, 1909. No. 6368 N.

The Testing of Transformer Steel. M. G. Lloyd and J. V. S. Fisher. Discusses the conditions which should be realized in the measurement of energy losses in sheet-iron and steel subject to alternating magnetization, describing a modification of the Epstein method and apparatus. 6000 w. Pro Am Inst of Elec Engrs—July, 1909. No. 6600 F.

Corona Phenomena in Air and Oil and Their Relation to Transformer Design. W. S. Moody and G. Faccioli. Describes experiments made, showing the complex nature of the study. Ills. 5800 w. Pro Am Inst of Elec Engrs—July, 1909. No. 6485 F.

The Leakage Field and Leakage Coefficients of a Transformer with Disc Winding and Divided End Coils (Ueber das Streufeld und den Streukoeffizienten eines Transformators mit Scheibenwicklung und geteilten Endspulen). W. Rogowski. Mathematical. Ills. 2200 w. Zeitschr d Ver Deutscher Ing—June 12, 1909. No. 6726 D.

The Practical Aspects of Recent Improvements in Transformers. W. A. Layman. Read before the N. E. L. A. Points out the way in which some of the improvements have been made possible. 2500 w. Elec Age—June, 1909. No. 6134.

Distributing Transformers. E. G. Reed. Traces the development, showing the requirements, and discussing the electrical and mechanical characteristics. Ills. 4500 w. Elec Jour—July, 1909. No. 6437.

"C. M. B." Patent Direct-Current Rotary Transformer. J. C. Macfarlane and H. Burge. Describes the construction and discusses applications. Ills. 3500 w. Elec Engr, Lond—July 9, 1909. No. 6418 A.

Electrical Measurements on Circuits Requiring Current and Potential Transformers. L. T. Robinson. Discusses the causes which make certain corrections necessary either in the manufacture of the transformer or in their use; methods for determining the variations; and the corrections. Ills. 7000 w. Pro Am Inst of Elec Engrs—July, 1909. No. 6498 F.

Voltage Losses.

Chart for Calculation of Voltage Losses. H. P. Liversidge. Gives chart, describing its construction and use. 1200 w. Elec Rev, N Y—July 31, 1909. No. 6787.

Voltage Regulation.

The Determination of the Current and Voltage Relations in Unsymmetrical Polyphase Systems. Charles H. Porter. Deals with a method which solves the problems as easily as corresponding problems in direct-current work, using simultaneous vector equations. 1200 w. Elec Wld—July 29, 1909. No. 6763.

We supply copies of these articles. See page 1048.

Voltage Regulation on a Three-Wire Network (Ueber eine Spannungsregulierung in Dreileiternetzen). F. Niethammer and R. Czepet. Describes a system. Ills. 1700 w. Elektrotech u Maschinenbau—June 27, 1909. No. 6718 D.

MISCELLANY.

Calculating Device.

An Electrical Device for Solving Equations. Describes the device presented by Alexander Russel and Arthur Wright to the Physical Society of London, which can solve equations to the *n*th degree, besides performing other calculations. 1000 w. Elec Wld—July 15, 1909. No. 6337.

Electric Clocks.

Electric Clocks for Railway Service (Elektrische Uhren mit besonderer Berücksichtigung für die Eisenbahnen). Herr Zacharias. Discusses the requirements of railway time service and the advantage of electric clocks. 2500 w. Glasers Ann—June 15, 1909. No. 6589 D.

Electric Pianos.

Electric Pianos (Pianos électriques). Georges Dary. Illustrated description of their mechanism and electrical connections. 3000 w. L'Elecn—June 5, 1909. No. 6533 D.

Montreal.

Electric Light and Power at Montreal. William H. Stuart. Describes the electric light and power business as conducted by the Montreal Heat, Light, and Power Co. 2200 w. Elec Wld—July 1, 1909. No. 6105.

INDUSTRIAL ECONOMY.

Accounting.

Modern Methods and the Business Specialist. Ellsworth M. Taylor. On the new development in business practice, and the need of scientific systematic methods. 3500 w. Ir Age—July 15, 1909. No. 6341.

Inventory Books for Industrial and Manufacturing Plants for the Control of Depreciation and Insurance Allowances (Inventarienbücher für Maschinen und Werkzeuge zur Kontrolle der Abschreibungen und der Feuerversicherungspolizzen). C. M. Lewin. An explanation of the method of keeping a continuous inventory. Ills. 4500 w. Elektrotech u Maschinenbau—June 20, 1909. No. 6717 D.

Education.

Present Tendencies in Technical Education. Frederick E. Turneaure. Extract from presidential address to the Soc. for the Promotion of Engng. Education. Deals with the technical training needed. 1500 w. Eng News—July 1, 1909. No. 6089.

Practical Work for College Professors. Charles Buxton Going. Abstract of a paper read before the Soc. for Promotion of Engng. Education. Considers the need of more intimate knowledge of actual working conditions. 3000 w. Ir Trd Rev—July 1, 1909. No. 6111.

The Value of the Classics in Engineering Education. Charles P. Steinmetz. Considers the study of the classics important and valuable to engineers. 1500 w. Pro Am Inst of Elec Engrs—July, 1909. No. 6492 F.

The Five-Year Courses. William T. Magruder. Read before the Soc. for Pro. of Engng. Ed. Presents the need of a lengthened course to meet the requirements of students paying their own way. 2000 w. Eng Rec—July 24, 1909. No. 6644.

Electrical Laboratory Equipments of the College of the City of New York. W. M. Schoonmaker. Describes an extensive and elaborate arrangement of apparatus. Ills. 1500 w. Elec Wld—July 29, 1909. No. 6764.

The Birmingham University. C. Alfred Smith. Illustrated description of the buildings and their equipment, especially the recent developments. Plate. 6000 w. Engng—July 2, 1909. Serial, 1st part. No. 6304 A.

The Engineering Equipment of Birmingham University. Describes the new laboratories largely devoted to the various branches of applied science. 3500 w. Engr, Lond—June 25, 1909. No. 6284 A.

The Engineering Department of the Victoria University, Manchester. Reviews the progress of engineering education at this university, and gives illustrated description of the new laboratories. 2500 w. Engng—July 16, 1909. No. 6684 A.

Imperial Railways of North China Engineering and Mining College, Tang Shan. Illustrated description of an institution regarded as an important center for the introduction of Western science in China. 1600 w. Engng—June 18, 1909. No. 6040 A.

The Necessity of a Transformation in Mining Education (Ueber die Notwendigkeit einer Umgestaltung des montanistischen Hochschulunterrichtes). Albert Sailler. A discussion of mining education in Austria. 2800 w. Oest Zeitschr f Berg u Hüttenwesen—June 19, 1909. No. 6570 D.

We supply copies of these articles. See page 1058.

Expositions.

The Alaska-Yukon-Pacific Exposition —The Fair That Was Ready. A. J. Quigley. An illustrated article outlining the plan, scope and results. 2500 w. Engineering Magazine—Aug, 1909. No. 6749 B.

Engineering Features of the Alaska-Yukon-Pacific Exhibition. Brief illustrated description. 800 w. Eng News—July 1, 1909. No. 6081.

Industrial Museums.

The Transportation and Construction Museum in Berlin (Ueber das Kgl. Verkehrs- und Baumuseum in Berlin). E. A. Ziffer. Describes the building and exhibits. Ills. 5200 w. Mitt d Ver f d Ford d Local u Strassenbahnwesens—May, 1909. No. 6559 F.

Management.

A Simple but Effective System for an Engineering Works. Frederick C. Herlan. Outlines a system adopted in an English factory. 2500 w. Ind Engng—July 15, 1909. No. 6676 C.

Tariff.

The Metal Schedule as Revised by the Senate. The complete text of Schedule C of the new tariff bill, showing the changes the Senate has made in the Payne bill as passed by the House of Representatives. 9000 w. Ir Age—July 8, 1909. No. 6216.

Wage Systems.

The Premium System of Wage Payment. C. B. Lord. Read before the Nat. Met. Trds. Assn. Discusses some of the difficulties attending its application. 4500 w. Am Mach—Vol. 32. No. 30. No. 6761.

Some Notes on Engineering Premium Systems. Describes systems introduced in old works which changed losses to profits. 1700 w. Mech Wld—June 18, 1909. Serial, 1st part. No. 6038 A.

A Double-Rate Premium Plan. H. F. MacLane. Briefly considers other wage systems, and describes and illustrates the double-rate plan. 3000 w. Am Mach—Vol. 32. No. 29. No. 6612.

MARINE AND NAVAL ENGINEERING.

Battleships.

International Competition in Battleship Design. Editorial on the designs of different nationalities, submitted to the Spanish Government. 3000 w. Engng—July 16, 1909. No. 6685 A.

Cable Steamers.

The Telegraph Ship "Telconia." Illustrations, with short description, of a new cable-repairing vessel. 1000 w. Elect'n, Lond—July 16, 1909. No. 6670 A.

Clermont.

Launch of the Reproduced Clermont of Robert Fulton. An illustrated account of the ceremonies and a description of the vessel. 7000 w. Naut Gaz—July 22, 1909. No. 6652.

Derricks.

Mast and Derrick Mountings. Illustrated descriptions. 1000 w. Int Marine Engng—July, 1909. No. 6076 C.

Destroyers.

The New British Destroyers. A critical discussion of the methods of the British Admiralty. 2500 w. Cassier's Mag—July, 1909. No. 6348 B.

Brazilian Torpedo-Boat Destroyers. Illustrated description of these vessels and their equipment. 3500 w. Engr, Lond—July 2, 1909. No. 6309 A.

Dredges.

A Modern Oyster Dredge. Francis K. Wilson, Jr. Remarks on oyster culture, with illustrated description of a dredge known as the "J. Van Wyne." 2000 w. Eng News—July 29, 1909. No. 6770.

Recent Dredge Construction (Neuere Baggerkonstruktionen). Herrn Paulmann and Blaum. Describes recent dredges for deep-water work. Ills. Serial, 1st part. 4500 w. Zeitschr d Ver Deutscher Ing—June 19, 1909. No. 6727 D.

Electrically Operated Dredges (Elektrisch betriebene Bagger). R. Richter. Describes in detail several electric dredges. Ills. Serial, 1st part. 3300 w. Zeitschr d Ver Deutscher Ing—June 12, 1909. No. 6725 D.

Ferryboats.

International Steam Ferries. Information in regard to the new direct steam-ferry connection inaugurated between Sweden and Germany. 1500 w. Engng—July 9, 1909. No. 6426 A.

See also Train Ferries, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

Fireboats.

Fireboat W. A. McGonagle. Illustrated description of a vessel for the protection of Duluth harbor. 1500 w. Marine Rev—July, 1909. No. 6321.

Ice Breakers.

Canadian Ice-Breaking and Passenger Steamer. Illustration and description of the "Earl Grey" recently launched. 1200 w. Engng—June 18, 1909. No. 6044 A.

A New Contribution on Methods of Preventing the Formation of Ice in Maritime and Inland Waterways (Nouvelle Contribution aux Etudes des Procédés de Déglaçages maritimes et fluviaux). M.

Dibos. Describes ice breakers designed for use in Russian harbors. Ills. 2000 w. Mem Soc Ing Civ de France—May, 1909. No. 6504 G.

Internal-Combustion Engines.

Large Internal-Combustion Engines for Land and Marine Purposes. Prof. W. H. Watkinson. Abstract of a paper read before the Liverpool Engng. Soc. A review of the development and applications, advantages, etc. 5000 w. Mech Engr—June 18, 1909. No. 6035 A.

Model Basins.

The Management and Equipment of an Experimental Tank. Discusses the general arrangement of such tanks, their equipment, etc. 4500 w. Engr, Lond—July 16, 1909. Serial, 1st part. No. 6687 A.

Motor Boats.

The Small Motor Boat. Harold Whiting Slauson. Deals with its care and operation. 2500 w. Sci Am Sup—July, 1909. No. 6624.

A Pressure Feed Fuel Supply System for Motor Boats. Carroll Le Roy Mosher. Explains the advantages and a simple method of installation. 2000 w. Naut Gaz—July 8, 1909. No. 6230.

Propellers.

Propeller Computations. Charles S. Linch. Explains computations by Durand's method, and by Taylor's method, showing how closely they agree. 1000 w. Int Marine Engng—July, 1909. No. 6077 C.

Simple Method of Propeller Design. Charles S. Linch. Gives computations and describes methods of designing the blade. 1800 w. Int Marine Engng—July, 1909. No. 6075 C.

Propeller-Testing Apparatus. Illustrates and describes the Westinghouse apparatus for testing screw propellers. 1000 w. Engng—July 2, 1909. No. 6307 A.

Repair Ship.

The Naval Repair Ship "Cyclops." Illustrated description of a completely equipped floating factory. 4500 w. Engng—July 16, 1909. No. 6682 A.

Shipbuilding.

The Scantlings of Steel Vessels. Gives Lloyds new rules for ships' scantlings, with explanatory statement, and editorial comment. 5000 w. Engng—June 25, 1909. No. 6281 A.

The Works of Harland and Wolff, Limited, at Belfast. Illustrated description of these shipbuilding and engineering works, with illustrations of vessels built and their history. 16000 w. Engr, Lond—June 18, 1909. No. 6048 A.

The Shipbuilding and Engineering Company of Akers Mekaniske Verksted, A. Gundersen. History and illustrated description of these shipbuilding works in Norway. 2500 w. Int Marine Engng—July, 1909. No. 6073 C.

Steam Engines.

A Practical Comparison of the Advantages of Higher Cylinder Ratios. C. S. Root. An account of two moderately long runs of the same vessel with different cylinder ratios. 2000 w. Int Marine Engng—July, 1909. No. 6079 C.

The Marine Steam Engine Indicator. Charles S. Root. Aims to present the best features of standard literature, and to give a résumé of present practice. Ills. 2500 w. Int Marine Engng—July, 1909. Serial, 1st part. No. 6078 C.

See also Steam Turbines, under MARINE AND NAVAL ENGINEERING.

Steamships.

The Orient Company's Australian Mail Liner "Osterley." Plate and illustrated description of the mechanical equipment, with report of steam trials. 2000 w. Engng—June 25, 1909. No. 6283 A.

Fruit and Passenger Steamer "Tortuguero." Illustrations and particulars of a recently built vessel for service between the West Indies and England, which possesses interesting systems of ventilation and refrigeration. 4000 w. Engr, Lond—July 9, 1909. No. 6428 A.

S. S. "George Washington." Illustrated description of this new first-class twin-screw passenger and freight steamship of the North German Lloyd. 1400 w. Int Marine Engng—July, 1909. No. 6080 C.

North German Lloyd Twin-Screw Passenger and Freight Steamer ("Berlin" (Der Doppelschrauben-Passagier- und Frachtdampfer "Berlin" des Norddeutschen Lloyd). Otto Lienau. A detailed description. Ills. 28000 w. Schiffbau—June 23, 1909. No. 6586 D.

Steam Turbines.

The Steam Turbine and the Reciprocating Engine for Marine Propulsion. Ira N. Hollis. Concluding article of a discussion with deductions. 2500 w. Engineering Magazine—Aug., 1909. No. 6750 B.

The Prospects of the Various Systems of Steam Turbines for Marine Work (Ueber die Aussichten der verschiedenen Dampfturbinen-Systeme im Schiffsturbinenbau). H. Jansson. A comparative discussion. 1600 w. Die Turbine—June 20, 1909. No. 6583 D.

Superheating.

Superheated Steam in Marine Work. F. J. Rowan. Illustrates and describes superheater constructions and applications. 4500 w. Int Marine Engng—July, 1909. Serial, 1st part. No. 6074 C.

Torpedo Testing.

Reinforced-Concrete Torpedo-Testing Station in the Bay D'Hyeres, near Toulon, France. Abstract translation of a paper by M. Michel-Schmidt. Illustrates and describes construction details. 3000 w. Eng News—July 8, 1909. No. 6224.

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MECHANICAL ENGINEERING.

AUTOMOBILES.

Albion.

The 24-30 h. p. Albion Car. Illustrates and describes a car of Scottish origin. 2000 w. Autocar—June 19, 1909. No. 6026 A.

Argyll.

The 12-14 h. p. Four-Cylinder Argyll. Illustrated description of a medium-priced car, with report of an officially observed run over the Scottish trials course. 3000 w. Autocar—July 17, 1909. No. 6661 A.

Axles.

Determining the Dimensions of the Rear Axles of Motor Cars with Cardan Gear (Beiträge zur rechnerischen Bestimmung der Dimensionen von Hinterachsen an Motorwagen mit Kardanantrieb). Ills. Serial, 1st part. 3000 w. Zeitschr d Mit Motorwagen Ver—June 15, 1909. No. 6593 D.

Bodies.

Body Builders Now Exercising Much Ingenuity. Illustrations and remarks on recent designs. 1400 w. Automobile—July 8, 1909. No. 6214.

Commercial Vehicles.

Details of New York Motor Mail Service. Describes the service and vehicles. Ills. 1600 w. Com Vehicle—July, 1909. No. 6103 C.

Competitions

The Scottish Automobile Club Reliability Trial. A report of the trial, giving tabulated particulars of cars and their performance. 4500 w. Engng—July 16, 1909. No. 6686 A.

Crossley.

The New 12-14 h. p. Crossley Chassis. Illustrated description. 1200 w. Autocar—June 26, 1909. Serial, 1st part. No. 6267 A.

Electric.

New Nickel-Iron Battery Withstands Tests. Describes this Edison battery and reports tests. 2000 w. Automobile—July 15, 1909. No. 6364.

The New Battery Charging Station at the Montague Street Garage of the Brighton, Hove & Preston United Omnibus Co. Illustrated description of the Stevens' charging set adopted. 1800 w. Elect'n, Lond—June 25, 1909. No. 6277 A.

Gasoline-Electric.

Gasoline Electric Automobiles. Justus B. Entz. Briefly reviews systems in which the prime mover is a gasoline engine, and electricity used as a supplementary power, especially describing the Entz electric transmission system. Ills. 3000 w. Jour Fr Inst—July, 1909. No. 6355 D.

Humber.

A Speedy Sixteen. Illustrated description of the new 16 h. p. model of the Humber Co. 1200 w. Auto Jour—July 10, 1909. No. 6413 A.

Ignition.

The Development of Magneto Ignition. H. G. Deupree. A review of the three successive steps marking the progress. Ills. 2500 w. Automobile—July 1, 1909. No. 6113.

Knox.

1910 Knox Pleasure Cars. Interesting details are illustrated and described. Engines water-cooled, aluminum crank case, etc. 2500 w. Automobile—July 29, 1909. No. 6779.

Martini.

A Swiss Solution of the Small Car Problem. Illustrated description of the latest 10-12 h. p. Martini model. 1200 w. Auto Jour—July 3, 1909. No. 6290 A.

Maxwell.

"Maxwell" Model Q. Illustrated description. 1300 w. Automobile—July 15, 1909. No. 6365.

Motor Balancing.

Balancing Petrol Motors. Considers some of the means of diminishing vibration. Ills. 1800 w. Autocar—July 10, 1909. No. 6403 A.

Motor Cylinders.

Functions and Frailties of Motor Cylinders. Thomas J. Fay. The present number discusses the correct designing of cylinders. Ills. 2000 w. Automobile—July 1, 1909. Serial, 1st part. No. 6112.

Motor Lubrication.

The Lubrication of Petrol Motors. Explains the conditions of the problem, and describes systems used. Ills. 2500 w. Engng—June 18, 1909. No. 6043 A.

Motors.

Flexibility Desirable in Automobile Motors. E. Girardault. A study of the factors bearing upon this quality, and the influence upon the design of the car, and particularly on the change-speed gear. 2000 w. Automobile—July 22, 1909. No. 6634.

A Constant Pressure Engine. Morris A. Hall. Illustrated description of the Stilz constant pressure internal combustion engine. 1500 w. Automobile—July 8, 1909. No. 6213.

Motor Testing.

A Handy Testing Chart. Arranged by Roger B. Whitman to show the effect of

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various troubles in automobile engines and how to remedy them. 700 w. Sci Am Sup—July 10, 1909. No. 6242.

Peerless.

The Peerless Motor Cars for 1910. Illustrated article describing improvements introduced. 1800 w. Automobile—July 29, 1909. No. 6778.

Rider-Lewis.

Rider-Lewis Sixes. Morris A. Hall. Illustrated description of features. 1500 w. Automobile—July 22, 1909. No. 6637.

Shock Absorbers.

Shock Absorbers (Les Amortisseurs). E. Girardault. Description and discussion of various types. Ills. Serial, 1st part. 4000 w. All Indus—June, 1909. No. 6543 D.

Stevens-Duryea.

1910 Stevens-Duryea. Illustrated description of the 6-cylinder, 40-h.p. car called Model Y. 2000 w. Automobile—July 22, 1909. No. 6635.

Tires.

A Simple Antidote to Tire Troubles. Illustrated article giving details of construction, manipulation, and management of the Dunlop detachable rim. 2500 w. Auto Jour—July 3, 1909. No. 6291 A.

The Making of Automobile Tires. Snowden B. Redfield. Illustrated description of modern machinery and methods used. 4500 w. Am Mach—Vol. 32. No. 30. No. 6759.

Turner-Miesse.

The Turner-Miesse Steam-Car. Illustrated description of a car claiming economy, safety, absence of vibration and easy control. 1800 w. Engng—July 2, 1909. No. 6305 A.

Valve Grinding.

Methods of Valve Grinding. D. R. Hobart. Discusses grinding as a cause of leakage, giving suggestions. Ills. 1500 w. Automobile—July 1, 1909. No. 6114.

Wheels.

A New Spare Wheel. Illustrates and describes the Hall spare wheel, designed so that it can be attached without fitting or deflating the tire. 8000 w. Auto Jour—July 17, 1909. No. 6660 A.

Winton.

Winton Six for 1910. This new model shows an improved carbureter, a new front axle, longer wheel base and springs, and other changes. Ills. 2000 w. Automobile—July 22, 1909. No. 6636.

Wolseley-Siddeley.

A 6-Cylinder Car of Moderate Power. Illustrates and describes a new Wolseley model of a low-priced 20-30 h. p. car. 800 w. Auto Jour—July 17, 1909. No. 6659 A.

COMBUSTION MOTORS.

Exhaust Gases.

See Exhaust-Gas Heating, under HEATING AND COOLING.

Fuels.

Tests of the Comparative Efficiency of Gas, Gasoline and Alcohol as Fuel in Internal Combustion Engine. Condensed from a thesis for the degree of Bachelor of Engineering, submitted by Ralph C. Puckett and Louis Hoth. Ills. 2500 w. Transit—June, 1909. No. 6482 N.

Gas Calorimetry.

Apparatus for Measuring and Indicating the Explosive and Calorific Values of Gaseous Mixtures. Illustrated description of an apparatus for continuous analysis of gaseous mixtures, recently patented by A. G. Evans. 1400 w. Mech Engr—June 18, 1909. No. 6036 A.

Gas Engines.

Recent Developments in Large Gas-Engine Design. Percy R. Allen. The present paper discusses the four-cycle gas engine in British and Continental practice. Ills. 4500 w. Cassier's Mag—July, 1909. Serial, 1st part. No. 6344 B.

The Producer Gas and Gas Engine, with Special Reference to the Down-Draft Producer. Thomas F. Fitzsimmons. Considers the generation of producer gas from low-grade fuels. 1500 w. Am Gas Lgt Jour—July 5, 1909. No. 6102.

Gas Engine Construction for Producer Gas Use. H. F. Smith. Read before the Nat. Gas & Gasoline Eng. Trds. Assn. Discusses the general requirements and certain details of importance. 2000 w. Gas Engine—July, 1909. Serial, 1st part. No. 6441.

The Gas Engine in Central Station Work. William F. Flint. Read before the Canadian Elec. Assn. Considers the economic possibilities. 2500 w. Ir Age—July 22, 1909. No. 6603.

Suction Gas-Engines at the Royal Agricultural Show. Illustrations, with description. 500 w. Engng—June 18, 1909. No. 6045 A.

See also Pumping Engines, under HYDRAULIC MACHINERY.

Gasoline Engines.

Rating of Petrol Engines. Considers the objects of having a rating rule, and the various suggestions for rating. 4500 w. Engng—June 25, 1909. No. 6278 A.

Light Explosion Motors for Dirigible Balloons and Aeroplanes (Les Moteurs à Explosion légers pour Dirigeables et Aéroplanes). Ch. Dantin. Discusses the requirements of an aeronautical motor and describes types. Ills. Serial, 1st part. 4000 w. Génie Civil—June 5, 1909. No. 6547 D.

Gas Producers.

The Suction Gas Producer for Small Power Plants. C. J. Atkinson. Read before the Nat. Gas & Gasoline Eng. Trds. Assn. Describes the process of making the gas, and applications made.

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2500 w. Gas Engine—July, 1909. No. 6439.

The S. F. H. Gas Producer, Cleaned by Fusion of the Cinder (Note sur le Gazogène S. F. H. a Décrassage par Fusion des Cendres). M. Sepulchre. A brief description, presented by the inventor before the Congress of Applied Chemistry. Ills. 1700 w. Rev de Métal—June, 1909. No. 6511 E + F.

Ignition.

The Science of a Jump Spark Coil. J. A. Williams. Read before the Gas & Gasoline Eng. Trds. Assn. Analyzes the coil, explaining the function of each part, and considers the action. 3300 w. Gas Engine—July, 1909. No. 6440.

The Science of the Jump Spark Coil. J. A. Williams. Read before the Gas Eng. Trds. Assn. Describes the various parts of the spark coil and their functions, and how they act. 3000 w. Naut Gaz—July 8, 1909. No. 6231.

HEATING AND COOLING.

Boilers.

See Boiler Rating, under STEAM ENGINEERING.

Central Plants.

Facts About City or District Steam. John V. Stout. Remarks on its advantages and disadvantages when used for heating buildings. 1400 w. Heat & Vent Mag—July, 1909. No. 6472.

The Problems of the Municipal Heating Engineer (Ueber die Aufgaben der Städt Heizungsingenieure). Herr Arnoldt. Discusses principally the letting of contracts for the installation of heating plants, methods of testing, etc. 8300 w. Gesundheits Ing—June 26, 1909. No. 6704 D.

Errors.

Experiences in Heating (Erfahrungen in Heizungsfach). Otto Ginsberg. Discusses a number of common errors in heating practice. Ills. Serial, 1st part. 5000 w. Gesundheits-Ing—June 19, 1909. No. 6703 D.

Exhaust Gas Heating.

Heating by the Waste Gases from Oil Engines (Verwendung der Dieselmotorenabwärme zu Heiz- und Warmwasserbereitungszwecken). M. Hottinger. A report of tests. 2300 w. Gesundheits-Ing—June 26, 1909. No. 6705 D.

Fan Blast.

See Hot-Air Heating, under HEATING AND COOLING.

Hot-Air Heating.

Report of the Committee on Fan-Blast Heating. Also tables and related matter. 3000 w. Am Soc Heat & Vent Engrs—July 15, 1909. No. 6465 N.

Fan-Blast Heating Data. Supplementary report of committee, presented to the Am. Soc. of Heat. & Vent. Engrs. 2000 w. Met Work—July 31, 1909. No. 6785.

Hot-Water Heating.

Rapid-Circulation Hot-Water Heating (Turul Schnellumlaufheizung). E. Segesvary. Discusses the advantages of rapid circulation. Ills. 2200 w. Gesundheits-Ing—June 5, 1909. No. 6702 D.

Pipe Radiation.

Calculations for Heat Losses from Pipes. William M. Grosvenor. Gives curve sheet for simplifying calculations, with explanation. Chart. Presented at meeting of Am. Soc. of Chem. Engrs. 1000 w. Heat & Vent Mag—July, 1909. No. 6471.

Radiators.

The Effect of Painting Radiating Surfaces. John R. Allen. Describes experiments conducted at the Experimental Laboratory of the University of Michigan. 1200 w. Am Soc of Heat & Vent Engrs—July 15, 1909. No. 6470 N.

Refrigeration.

The Absorption Refrigerating Machine. W. E. Crane. Explains the different parts and their functions and gives advice as to care and operation. 5500 w. Power—June 29, 1909. No. 6022.

The Capacity of Refrigerating Machines. F. E. Matthews. Explains methods of determination, illustrating by example. 3000 w. Power—July 6, 1909. No. 6202.

Air Cooling by Refrigeration. W. W. Macon. Read before the Am. Soc. of Heat. & Vent. Engrs. Discusses the determining requirements of refrigerating apparatus, giving charts for facilitating calculations. 6000 w. Ice & Refrig—July, 1909. No. 6191 C.

School Buildings.

Safeguarding Our Profession. William M. Mackay. Remarks on faulty designs, especially considering school heating and ventilating plants. 2000 w. Am Soc of Heat & Vent Engrs—July 15, 1909. No. 6469 N.

Steam Heating.

Heating and Ventilating System, Finney Chapel, Oberlin College, Oberlin, Ohio. B. S. Harrison. Sketches and description of the system adopted. 900 w. Am Soc of Heat & Vent Engrs—July 15, 1909. No. 6468 N.

Ventilation.

Ventilating a Twelve-Story Loft Building in New York. Illustrated description of a heating plant complying with the factory ventilating law. 1500 w. Met Work—July 10, 1909. No. 6244.

Ventilation of a Newspaper Photo-Engraving Plant. Illustrated description of a ventilating system in the photo-engraving department of San Francisco "Call," for the removal of fumes. 2000 w. Eng Rec—June 26, 1909. No. 6000.

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Wind Effects.

Examples of Wind Effects on Ventilation and Heating. H. W. Whitten. Reports results of recent tests. 1500 w. Am Soc of Heat & Vent Engrs—July 15, 1909. No. 6467 N.

HYDRAULIC MACHINERY.

Accumulators.

A System of High and Low Pressure Hydraulic Accumulators. R. F. Williams. Illustrates and describes an interesting hydraulic system at the Montreal works of the Am. Loc. Co. 700 w. R R Age Gaz—July 9, 1909. No. 6232.

Centrifugal Pumps.

The Graphical Design of Centrifugal Pumps (Application du Calcul graphique aux Pompes centrifuges). M. Lecuir. Mathematical. Ills. 2000 w. Rev de Mécan—June, 1909. No. 6526 E + F.

Vane Construction (Die gegenwärtige Lage des Schauflerbaues). Egon Eickhoff. Discusses modern practice in vane design for centrifugal and turbine pumps. 3200 w. Die Turbine—May 20, 1909. No. 6580 D.

Centrifugal Pump Discharges (Ueber Entlastungsvorrichtungen bei Zentrifugalpumpen). Otto Gottschling. Discusses various designs. Ills. 3000 w. Die Turbine—June 5, 1909. No. 6582 D.

Methods of Priming Centrifugal Pumps. John B. Sperry. Describes some of the more common systems in use, giving directions for the proper handling of each. Ills. 2500 w. Power—July 20, 1909. No. 6434.

Special Duty Centrifugal Pumps. John B. Sperry. Suggestions for the use of standard pumps for special duty. Ills. 1500 w. Power—July 13, 1909. No. 6314.

Pumping Engines.

Compound Cornish Pumping Engines. W. Percy Gauvain. Remarks on the latest type of these engines, and the general principles which govern the working. Ills. 2200 w. Min & Sci Pr—July 10, 1909. No. 6319.

Working Results of Pumping Engines Operated by Producer Gas. D. Hastings Irwin. Read before the Assn. of Water Engrs. Gives data taken from plants in operation. 2000 w. Surveyor—July 9, 1909. No. 6416 A.

Pumping Plants.

Steam-Driven Pumping Plant for Deep Wells and Boreholes. Alfred Towler. Read before the Assn. of Water Engrs. Considers plants in which the engine is out of suction distance from the water to be pumped, indicating the principles affecting the durability and efficiency of rod pumps. Ills. 6000 w. Mech Engr—July 2, 1909. No. 6299 A.

Winnipeg High-Pressure Fire Service. Illustrated description of the gas-driven high-pressure fire service water supply installed at a cost of nearly a million dollars. 2500 w. Engr, Lond—June 25, 1909. No. 6286 A.

Turbine Design.

Turbine Diagrams (Ueber Turbinendiagramme). E. Braun. Mathematical discussion of the graphical design of water turbines. Ills. 1600 w. Zeitschr f d Gesamte Turbinenwesen—June 30, 1909. No. 6585 D.

Turbine Plants.

A Pelton-Francis Turbine Installation at Schaghticoke, N. Y. Illustrated description of a 20000 horse power installation. 1500 w. Ir Age—July 15, 1909. No. 6342.

The Luzern-Engelberg Water-Power Plant (Die Wasserkraftanlage Luzern-Engelberg). Andreas Stamm. Describes interesting features of the turbine installation. Ills. 1800 w. Die Turbine—June 20, 1909. No. 6584 D.

Turbine Tests.

Brake Tests on a 300 Horse-Power Horizontal Turbine (Bremsresultate einer Kesselturbine von 300 P,S). Karl Gottwein. Describes the installation and gives results. Ills. 2000 w. Zeitschr d Oest Ing u Arch Ver—June 18, 1909. No. 6596 D.

Water Wheels.

Building Pelton Wheels. W. Burns. Brief illustrated description of methods used. 1200 w. Power—July 6, 1909. No. 6203.

MACHINE ELEMENTS AND DESIGN.

Ball Bearings.

Gages and Fixtures for Testing Ball Bearings. Illustrates and describes tools used. 2500 w. Am Mach—Vol. 32. No. 26. No. 6097.

See also Shop Practice, under MACHINE WORKS AND FOUNDRIES.

Bosses.

The Diameter and Length of Bosses. R. A. Lewis. Gives coefficients illustrating the prevailing proportions of a boss and arms to their shaft. 800 w. Engr, Lond—June 18, 1909. No. 6050 A.

Connecting Rods.

Stress Distribution in Connecting Rod Heads (Die Spannungsverteilung in geschlossenen Schubstangenköpfen). A. Watzinger. Mathematical and graphical discussion. Ills. 1800 w. Zeitschr d Ver Deutscher Ing—June 26, 1909. No. 6732 D.

Crank Shafts.

A System of Crank Shafts with Slotted Side Plates (Un Système d'Essieux coudés à Flasques évidées). Ed. Sauvage. Brief description of crank axles of which the side plates are not solid. Ills. 1300 w. Bul Soc d' Encour—May, 1909. No. 6522 G.

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Gears.

Ferguson's Mechanical Paradox. Illustrated description of an ingenious train of gears invented in 1750. 2000 w. Sci Am Sup—July 24, 1909. No. 6625.

Worm Gears (Die Schraubenräder). H. Witz and L. Gaisser. Mathematical discussion of their design. Ills. 2500 w. Zeitschr f Werkzeug—June 5, 1909. No. 6590 D.

Kinematics.

Instantaneous Axes and Their Application to the Solution of Problems in Kinetics. A. Spencer-Bower. A mathematical explanation of their utility in the determination of the relative velocities of two or more moving centers. Diagram. 2000 w. Mech Wld—June 25, 1909. Serial, 1st part. No. 6268 A.

Mechanics.

The Work of Recoil. Sir George Greenhill. Explanatory note. 500 w. Engr, Lond—July 16, 1909. No. 6692 A.

Rivetted Joints.

Rivetting Tests (Nietversuche). Results obtained by the German Bridge and Steel-Construction Company. Ills. 2200 w. Stahl u Eisen—June 16, 1909. No. 6566 D.

Slide-Rules.

A Duplex Slide-Rule with Log-Log Scales for Power and Root-Calculations. Explains an instrument which will simplify exponential calculations. Ills. 3500 w. Eng News—July 8, 1909. No. 6226.

Speed Changing.

A Variable Speed Gear. Arthur W. Jones. Illustrated description of an interesting gear designed for the bicycle. 1200 w. Am Mach—Vol. 32. No. 27. No. 6211.

Torsion.

The Theory of Torsion as Applied to Rectangular Prismatic Rods (Zur Theorie der Torsion rechteckig-prismatischer Stäbe). Rudolf Goetzke. Mathematical. Ills. 5000 w. Zeitschr d Ver Deutscher Ing—June 12, 1909. No. 6724 D.

MACHINE WORKS AND FOUNDRIES.

Automatic Machinery.

Comparison of Power Efficiency—No. 2 and No. 2-G B & S Automatic Screw Machines. A report of tests. Ills. 1200 w. Am Mach—Vol. 32. No. 26. No. 6096.

Brass Founding.

Repairing Broken Brass Castings. Ethan Viall. Illustrates and describes methods used in the brass foundry of the C. & A. railroad, at Bloomington, Ill. 800 w. Foundry—July, 1909. No. 6124.

Bronze Founding.

Casting a Colossal Bronze Statue. Illustrations and information concerning the monument to King Victor Emanuel II in Rome, Italy. 1000 w. Sci Am Sup—July 10, 1909. No. 6243.

Case Hardening.

Experiments on the Case Hardening of Steel by Gases. J. C. Olsen and John S. Weiffenback. Read at the Brooklyn meeting of the Am. Inst. of Chem. Engrs. (Abstract.) Carbon-monoxide found the best gas for the purpose. 1500 w. Ir Age—July 8, 1909. No. 6217.

Castings.

Steel Castings. A general discussion. Ills. 7000 w. Pro Engrs' Soc of W Penn—July, 1909. No. 6746 D.

Making Malleable Castings. An illustrated review of recent developments, referring to papers read before the American and British foundry associations. 2500 w. Ir & Coal Trds Rev—June 25, 1909. No. 6287 A.

See also Cleaning, under MACHINE WORKS AND FOUNDRIES.

Cleaning.

A New Process for Cleaning Iron with Recovery of Sulphate of Iron (Note sur un Procédé nouveau pour le Décapage du Fer et la Récupération du Sulfate de Fer). Georges Charpy. Brief description, read before the Congress of Applied Chemistry. Ills. 1200 w. Rev de Métal—June, 1909. No. 6509 E + F.

Straight- and Curved-Track Dipping Machines (Geradbahn- und Kreisbahn-Beizmaschinen). U. Lohse. Describes various machines for dipping sheets in cleaning solutions. Ills. Serial, 1st part. 2800 w. Stahl u Eisen—June 16, 1909. No. 6565 D.

Modern Plants for Cleaning Castings (Ueber moderne Gussputzanlagen). W. Caspary. Discusses the arrangement and equipment of the cleaning room and its relation to other parts of the plant. Ills. 2200 w. Stahl u Eisen—June 2, 1909. No. 6561 D.

Converters.

A Baby Converter Steel Foundry. Illustrated description of the construction, equipment, and operation of a small Tropenas converter steel casting plant at Newcastle, Delaware. 2500 w. Foundry—July, 1909. No. 6122.

Cupola Practice.

Economy in Cupola Melting. J. W. Henderson. Considers factors of economy involved in the conversion of pig iron, scrap, etc., into good castings. Ills. Discussion. 7000 w. Pro Engrs' Soc of W Penn—July, 1909. No. 6745 D.

Cutting Tools.

An Improved Lathe Tool and Tool-Holder. Describes the recent invention of James Hartness. Ills. 4500 w. Mech Engr—June 18, 1909. No. 6034 A.

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Damascening.

A New Process for Damascening, Inlaying, and Blending Metals. Illustrated description of the process and work produced. 1500 w. Sci Am—July 31, 1909. No. 6765.

Drilling.

Minimizing the Time of Drilling Operations. Alfred Spangenberg. Analyzi the elements that enter into rapid drilling, pointing out usual defects in methods and processes. 2500 w. Mach, N Y—July, 1909. No. 6071 C.

Forging Hammers.

The Bliss Compound Pneumatic Forging Hammer. Illustrated description. 1000 w. Ir Age—July 1, 1909. No. 6062.

Foundries.

Wheel Foundry and Foundry Methods; Norfolk & Western. George L. Fowler. Detailed account of wheel foundry practice at the Roanoke shops. Ills. 3000 w. R R Age Gaz—July 16, 1909. Serial, 1st part. No. 6379.

Modern Iron Foundry and Materials Yard. Features for facilitating the handling of materials at a large iron foundry in Milwaukee, Wis., are illustrated and described. 1000 w. Am Mach—Vol. 32. No. 27. No. 6209.

Foundry Accidents.

The Prevention of Accidents in Foundries. Reports to the American Foundrymen's Assn. of a special committee, of which Thomas D. West was chairman. Suggestions for prevention, safety devices, etc. Ills. 3000 w. Ir Age—July 22, 1909. No. 6602.

Jigs.

Hints to Jig Designers. A. Whitehead. Remarks on general principles. 1200 w. Mech Wld—July 16, 1909. Serial, 1st part. No. 6666 A.

Some Interesting Types of Drill Jigs. Illustrates and describes handy devices. 1500 w. Am Mach—Vol. 32. No. 27. No. 6212.

Standard Designs of Jigs and Fixtures for the Manufacture of Small Interchangeable Parts. Frank P. Crosby. Illustrations with concise descriptions of essential points. 1500 w. Mach, N Y—July, 1909. No. 6066 C.

Lathes.

Truing a Bench Lathe Bed. Walter Gribben. Illustrated description of the work. 1000 w. Mach, N Y—July, 1909. No. 6067 C.

Sellers Car-Wheel Lathe. Illustrated description of the machine and its operation. 1500 w. Mach, N Y—July, 1909. No. 6072 C.

Sellers 42-In. Car-Wheel Lathe. Illustrated detailed description. 2500 w. R R Age Gaz—July 23, 1909. No. 6633.

The Lodge & Shipley Marvel Lathe. Illustrated detailed description of an improved design primarily for the rapid production of duplicate parts. 2500 w. Ir Age—July 29, 1909. No. 6756.

Machine Tools.

Some Thoughts on Machine Tool Design. Forrest C. Cardullo. Considers speed and feed changes, vibration, bearings, and related subjects. 5000 w. Mach, N Y—July, 1909. No. 6065 C.

Molding.

The Permanent Mold and Its Effect on Cast Iron. E. A. Custer. Read before the Am. Soc. for Test. Mat. Gives results of investigations. Ills. 2500 w. Ir Trd Rev—July 15, 1909. No. 6366.

Molding a Cast Steel Bolster. H. J. McCaslin. Explains the problems involved and the method of solving them. Ills. 2800 w. Foundry—July, 1909. No. 6123.

Molding Sand.

A New Plant for the Preparation and Cleaning of Molding Sand (Eine neue Sandaufbereitung). C. Henning. Describes an elaborate installation in the Strebelwerk foundry, Mannheim. Ills. 4200 w. Stahl u Eisen—June 2, 1909. No. 6560 D.

Pattern Making.

Pattern Making for Steel Foundries (Die Schablonenformerei in Stahlformgiessereien). Leonard Treuheit. Discusses its importance and gives examples of difficult work. Ills. Serial, 1st part. 1700 w. Stahl u Eisen—June 2, 1909. No. 6562 D.

Pipe Making.

Plant Used in the Manufacture of Tubes. W. H. A. Robertson. Read before the Inst. of Metals. Describes the more important processes and the machines used. 4500 w. Mech Engr—July 2, 1909. No. 6298 A.

Pneumatic Tools.

See Forging Hammers, under MACHINE WORKS AND FOUNDRIES.

Saws.

The Management of Band Saws (Ueber die Behandlung von Blockbandsägen). David Dominicus. A discussion of their operation and care. Ills. Serial, 1st part. 2700 w. Zeitschr f Werkzeug—June 25, 1909. No. 6592 D.

Shop Hygiene.

Dust Removal in the Grinding Trades. C. Johnston and S. R. Bennett. From 1908 report of the Chief Inspector of Factories and Workshops. Describes experiments undertaken with a view to devising means to prevent inhalation of dust. 2800 w. Mech Engr—July 9, 1909. No. 6417 A.

Shop Appliances.

Milling, Bending and Testing Fixtures. Illustrates and describes how accurate machine parts are finished by special appliances. 2000 w. Am Mach—Vol. 32. No. 28. No. 6326.

We supply copies of these articles. See page 1048.

Shop Practice.

Machine Tool Practice for Maximum Production. Charles Day. Second article of a series, considering the design and construction of tools for specified performance. Ills. 3500 w. Engineering Magazine—Aug, 1909. No. 6747 B.

Machine Shop Practice. Discusses shrinking and forcing fits. Supplement. 1200 w. Mach, N Y—July, 1909. No. 6070 C.

The Making of Incandescent Electric Lamps. Illustrates and describes some of the automatic and semi-automatic machines employed, and the methods. 3000 w. Am Mach—Vol. 32. No. 29. No. 6611.

Making Steel Balls for Ball Bearings. Snowden B. Redfield. Illustrates and describes the methods of manufacture. 2000 w. Am Mach—Vol. 32. No. 28. No. 6328.

The Manufacture of Crank-Shafts. Illustrated detailed description of methods used by a Philadelphia manufacturer. 3500 w. Mach, N Y—July, 1909. No. 6069 C.

Making the Colt Automatic Pistol. Illustrated description of interesting features of the Colt Armory, at Hartford, Conn., and the methods used in working the parts so as to avoid brazed or screwed joints. 2500 w. Am Mach—Vol. 32. No. 28. No. 6324.

Manufacturing the Smith Premier Typewriter. Illustrated description of factory and methods. 5500 w. Ind Engng—July 15, 1909. No. 6675 C.

Automobile Cylinder and Piston Finishing. Hugh Dolnar. Illustrates and describes methods—especially the Cartercar practice. 1200 w. Am Mach—Vol. 32. No. 26. No. 6094.

Automobile Engine Cylinder and Piston Finishing Practice. Hugh Dolnar. Illustrates and describes the practice of the Am. Simplex Motor Car Company. 1200 w. Am Mach—Vol. 32. No. 27. No. 6208.

Machining Heavy Connecting-Rod, Bearing and Details. Describes the necessary operations and the machines advocated. Ills. 1500 w. Prac Engr—July 2, 1909. Serial, 1st part. No. 6296 A.

Shops.

A New Oil Engine Works. Brief illustrated description of new works at Hazel Grove, England. 1700 w. Engr, Lond—July 16, 1909. No. 6689 A.

The Vail Family and the Speedwell Works. Edward P. Buffet. An account of works near Morristown, N. J., which were recently burned. They were founded in Revolutionary times. 3500 w. Am Mach—Vol. 32, No. 28. No. 6327.

Shop Ventilation.

Compulsory Factory Ventilation. C. M. Ripley. A justification of the New York State law. 1800 w. Ir Age—July 8, 1909. No. 6215.

Watchmaking Machinery.

Some Machinery and Methods of Watchmaking. Ethan Viall. Illustrates and describes machinery and methods seen at the plant of the Illinois Watch Co., Springfield, Ill. 3000 w. Mach, N Y—July, 1909. No. 6064 C.

MATERIALS OF CONSTRUCTION.

Alloys.

Veeder Alloy (Veeder-Guss). Describes the properties of a cast tin alloy used in the manufacture of Veeder cyclometers. Ills. 2500 w. Giesserei-Zeit—June 1, 1909. No. 6568 D.

Alloy Steels.

Special Industrial Steels (Les Aciers spéciaux industriels). Léon Guillet. Read before the Congress of Applied Chemistry. Discusses the characteristics conferred by various alloys. 2000 w. Rev de Métal—June, 1909. No. 6517 E + F.

Brass.

Ingoted Scrap Brass and Bronze. Walter J. May. Brief discussion of its preparation and use. 800 w. Prac Engr—June 18, 1909. No. 6031 A.

Brasses and Copper (Laitons et Cuivre). Charles Grard. Describes mechanical tests, heat-treatment investigations and metallographic examinations. Ills. Serial, 1st part. 10000 w. Tech Mod—June, 1909. No. 6540 D.

Bronzes.

The Influence of Heat Treatment on Copper Alloys (Influence des Traitements thermique sur les Alliages de Cuivre). A. Portevin. Read before the Congress of Applied Chemistry. Results of experiments indicating that the properties of bronzes can be altered by heat treatment. 2400 w. Rev de Métal—June, 1909. No. 6518 E + F.

Heat Insulation.

The Practical Efficiency of Heat-Insulating Materials. Charles R. Darling. Gives a summary of results obtained during a series of tests on commercial laggings, and the conclusions reached. 2000 w. Engng—July 9, 1909. No. 6422 A.

Metallography.

The Industrial Applications of Metallography (Les Applications de la Métallographie à l'Industrie). Louis Revillon. Read before the Congress of Applied Chemistry. 1700 w. Rev de Métal—June, 1909. No. 6519 E + F.

The Magnetic Properties of Iron and the Study of Metals and Alloys (Le Ferromagnétisme et l'Etude des Métaux et Alliages). Pierre Weiss. Read before the Congress of Applied Chemistry. A dis-

We supply copies of these articles. See page 1048.

cussion of the importance of magnetic properties in the study of metallographic problems. Ills. 6500 w. Rev de Métal—June, 1909. No. 6508 E + F.

The Fatigue and Crystallization of Metals. Walter Rosenhain. Reviews evidence that metals are aggregates of crystals, discussing the conditions affecting the size of the crystals and their formation, and explaining "fatigue" failure. Discussion. Ills. 7000 w. Jour W of Scotland Ir & St Inst—Feb, 1909. No. 6456 N.

Steel.

The Heat Treatment of Steel (Remarques sur les Traitements Thermiques des Produits sidérurgiques). Léon Guillet. Read before the Congress of Applied Chemistry. Calls attention particularly to the importance of the time element. 1300 w. Rev de Métal—June, 1909. No. 6516 E + F.

Timber Drying.

Kiln Drying Lumber. Charles L. Hubbard. Discusses the drying of lumber by artificial means, describing various kinds of apparatus used. Ills. 2000 w. Dom Engng—July 17, 1909. Serial, 1st part. No. 6432.

Tool Steels.

U. S. Navy Specifications for Tool Steel. Henry Williams. Concerning the chemical composition and physical characteristics adopted by the Navy for purchase of tool steel. 4000 w. Am Mach—Vol. 32. No. 30. No. 6758.

Buying Carbon Tool Steel on Specifications. J. M. Darke. From the *Gen. Elec. Rev.* Gives the specifications drawn up, with a brief statement of methods of chemical analyses. 2000 w. Am Mach—Vol. 32. No. 30. No. 6760.

MEASUREMENT.

Air Meters.

The Measurement of Compressed Air. Prof. J. Orr. Read before the Trans. Inst. of Mech. Engrs. Illustrated description of meters for determining the amount of air at every temperature, passing through the meter. 2000 w. Mech Engr—July 16, 1909. Serial, 1st part. No. 6665 A.

Friction.

An Apparatus for Studying Friction. Illustrated description of the instrument devised by M. G. Derihon. 1200 w. Sci Am Sup—July 17, 1909. No. 6335.

Gages.

Gages Used in Making Comptometers. Illustrated description of gages for testing accuracy of machine work on levers, rods, cams, gears, etc. 2500 w. Am Mach—Vol. 32. No. 30. No. 6757.

End-Measuring Gauges (Zur Frage der Endmassnormale). August Bauschlicher. Their uses, types available, etc. Serial, 1st part. 2500 w. Zeitschr f Werkzeug—June 25, 1909. No. 6591 D.

The Johansson Combination Gauges (Les Calibres-Etalons à Combinaisons "Johansson"). A description of the merits of this new system. Ills. 4500 w. Rev de Mécan—June, 1909. No. 6529 E + F.

Micrometers.

Some Remarkable Printing Office Devices. Snowden B. Redfield. Illustrates and describes ingenious devices so sensitive as to distinguish a variation in thickness of one sheet of paper. 4000 w. Am Mach—Vol. 32. No. 26. No. 6093.

Pyrometry.

Workshop Pyrometry. Chas. R. Darling. An account of the present condition of pyrometry in relation to its industrial uses. 3000 w. Mech Wld—June 18, 1909. Serial, 1st part. No. 6037 A.

See also Coke Ovens, under MINING AND METALLURGY, COAL AND COKE.

Test Bars.

Perplexing Differences in the Tensile Strength of Round and Square Test Bars. A. Gustersen. Describes the writer's experience, where in every case the square bar showed a much higher tensile strength. 600 w. Brass Wld—July, 1909. No. 6478.

Testing Machines.

A Laboratory Machine for Applying Bending and Twisting Movements Simultaneously. E. G. Coker. From Pro. of the Phys. Soc., London. Illustrates and describes a machine for applying combined stresses. 2000 w. Engr, Lond—July 9, 1909. No. 6430 A.

Testing Methods.

Mechanical Tests of Cast Iron (Essais mécaniques de la Fonte). Ch. Frémont. A review of testing methods, with a description of a new machine and method of testing invented by the author. Ills. 6000 w. Bul Soc d'Encour—May, 1909. No. 6524 G.

POWER AND TRANSMISSION.

Air Compressors.

Three Cylinder, Two Stage, Steam Driven Air Compressor. Illustrations and description of one of the largest enclosed type machines ever built. 1800 w. Ir Trd Rev—July 1, 1909. No. 6110.

Belt Driving.

The Efficiency of Power Transmission by Belting (A propos du Rendement des Courroies de Transmission). Karl Kobes. Mathematical. Ills. 5500 w. Rev de Mécan—June, 1909. No. 6527 E + F.

Compressed Air.

See Air Meters, under MEASUREMENT.

Electric Driving.

Electric-Driven Rolling Mills. E. Friedlander. General discussion of the advantages and of details of installations. Also short paper by E. W. Yearsley, on Rolling Mill Motors. 3000 w. Pro Am Inst of Elec Engrs—July, 1909. No. 6487 F.

We supply copies of these articles. See page 1048.

Electric Driving for Weaving Machinery. Albert Walton. Illustrates and describes applications of individual electric motors to the direct operation of looms. 3000 w. Cassier's Mag—July, 1909. No. 6346 B.

See also Controllers, under ELECTRICAL ENGINEERING, DYNAMOS AND MOTORS.

Gears.

The Lecoche Frictionless Transmission Gear. Illustrated description of this interesting new invention. 800 w. Engng—July 2, 1909. No. 6306 A.

Hydraulic Transmissions.

A New Form of Hydraulic Gear for the Transmission of Power. Illustrates and describes an invention recently patented by H. S. Hele-Shaw. 1200 w. Prac Engr—July 9, 1909. No. 6414 A.

Lubricants.

The Selection of an Oil for Lubrication. Henry M. Wells and William Scott-Taggart. Gives reasons why physical tests are useless. 3000 w. Power—July 27, 1909. Serial, 1st part. No. 6697.

Mechanical Plants.

A Combination Ventilating, Heating and Cooling Plant in a Bank Building. A. M. Feldman. Gives data and results of a plant installed in a bank building in New York City. Ills. 3500 w. Am Soc of Heat & Vent Engrs—July 15, 1909. No. 6466 N.

Power Plants.

The Shop Power Plant. Charles L. Hubbard. Gives suggestions to guide in the selection of equipment. Ills. 5000 w. Ir Age—July 15, 1909. No. 6340.

Power Plant of the Apthorp Apartment, New York. Plan and description of a plant for a 12-story, steel-cage building, which possesses special features of interest. 3500 w. Eng Rec—July 17, 1909. No. 6398.

The Power Plant of the University of Alabama. F. H. Sibley. Illustrated description of plant furnishing light, heat and power. 1500 w. Elec Wld—July 22, 1909. No. 6614.

Rope Driving.

The Design of Chain and Rope Transmission Systems for Maximum Life (Comment construire les Transmissions par Câbles ou par Chaines pour réaliser le Maximum de Durée des Organes tracteurs). Ernst Heckel. Translated from *Stahl und Eisen*. Ills. 4000 w. All Indus—June, 1909. No. 6542 D.

Wind Power.

Wind Turbines. Brief illustrated description of a recent type. 500 w. Engr, Lond—June 18, 1909. No. 6052 A.

STEAM ENGINEERING.

Boiler Corrosion.

The Resistance of Land and Marine Boilers to Corrosion (Résistance des Générateurs de Vapeur industriels et marins aux Altérations corrosives). H. de la Coux. Discusses the causes of corrosion and incrustation in steam boilers. Ills. 5000 w. Tech Mod—June, 1909. No. 6538 D.

Boiler Explosions.

Disastrous Boiler Explosion at Denver. Illustrated detailed account, with editorial. 2500 w. Power—July 6, 1909. No. 6204.

Boiler Feeding.

Boiler Feeding (Kesselspeisevorrichtungen). A. Laponche. Discusses the various types of pumps and methods of driving. Ills. 5500 w. Die Turbine—June 5, 1909. No. 6581 D.

Boiler Fittings.

Boiler Blow-Out Valves. Discusses types and their defects. 2000 w. Prac Engr—June 25, 1909. No. 6269 A.

Boiler Management.

Care and Management of Water-tube Boilers. William Kavanagh. Directions for shutting down, cleaning and inspecting. 3000 w. Power—June 29, 1909. No. 6023.

Heat Transmission into Boilers. Henry Kreisinger and Walter F. Ray. Points out possible ways of more fully utilizing this ability in getting both better economy and higher capacities. 4500 w. Power—June 29, 1909. No. 6020.

Boiler Operation.

The Division of Work in a Boiler. T. F. J. Maguire. An analysis of the efficiency of the various parts of the heating surface. 2500 w. Ind Engng—July 15, 1909. No. 6680 C.

Boiler Plants.

The Design of Boiler Plants (Entwurf einer Dampfkesselanlage). Adolf Knelles. A method with simple mathematics. Ills. Serial, 1st part. 1400 w. Elektrotech Rundschau—June 23, 1909. No. 6709 D.

Boiler Rating.

Published Ratings of Heating Boilers Abroad. Review of the published ratings in use in England, France and Germany. 1200 w. Met Work—July 31, 1909. No. 6784.

A British View of Rating Heating Boilers. Full abstract of paper by A. H. Barker, read at Manchester, England. 3000 w. Met Work—July 10, 1909. No. 6245.

Boiler Regulations.

Italian Boiler Requirements. Information concerning the laws and regulations of Italy governing the construction and use of boilers. 1200 w. Power—July 27, 1909. No. 6696.

Boiler Repairs.

The Diagonal Patch. R. E. McNamara. Describes this method of remedying a bag, where the condition will permit its application, giving calculations and costs.

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Ills. 1800 w. Boiler Maker—July, 1909. No. 6187.

Boilers.

The Development of the Downflow Boiler. J. C. Parker. An illustrated explanation of the construction and principles, with related information. Short discussion. 7500 w. Pro Engrs' Club of Phila—Jan, 1909. No. 6359 D.

Boiler Tubes.

Corrugated Fire Tubes (Betrachtungen an einem Wellblechflammrohre). J. Schmidt. A mathematical discussion of their strength. Ills. 2500 w. Zeitschr d Ver Deutscher Ing—June 5, 1909. No. 6723 D.

The Strength of Oval Tubes under External or Internal Pressure (Résistance des Tuyaux ovales soumis à une Pression intérieure ou extérieure). M. Westphal. Mathematical. Ills. 4000 w. Rev de Mécan—June, 1909. No. 6528 E + F

Condensers.

The Choice of a Condenser. Francis Hodgkinson. Discusses the different types and points out the particular applications of each. 3000 w. Elec Jour—July, 1909. Serial, 1st part. No. 6436.

Notes on Condensing and Water-Cooling Plants. E. Lunn. Read before the Incor. Munic. Elec. Assn. Considers types of condensers and their efficiency, wet and dry air pumps, steam and electrically driven pumps, and water-cooling plants. 4000 w. Mech Engr—June 25, 1909. No. 6271 A.

Economizers.

A Practical Talk on the Economizer. Warren H. Miller. An illustrated discussion of how to handle economizers, and matters related. 3000 w. Power—July 27, 1909. No. 6699.

Engine Cylinders.

Thick Cylinders. P. M. Gallo. Gives formulae commonly used to calculate the thickness for a given pressure, and a diagram based on formula developed by the writer. 3000 w. Mach, N Y—July, 1909. No. 6068 C.

Engine Pistons.

Pistons and Piston Valves. The first of a series of illustrated articles deals principally with piston packings, and the principles under which packing rings should work. 4000 w. Engr, Lond—June 18, 1909. Serial, 1st part. No. 6047 A.

Engines.

Engineering in the Eighteenth Century. Edward P. Buffet. Illustrates engines used 150 years ago. 4200 w. Am Mach—Vol. 32. No. 26. No. 6095.

New York's First Corliss Engine. Thomas Wilson. Illustrates and describes the "Enterprise," in service since 1851 almost continuously, and good for many years to come. 1000 w. Power—June 29, 1909. No. 6021.

The "Lowca" High-Pressure Engine. Illustrated description of an engine designed to work with steam at pressures of as much as 1000 lbs. per square inch, and at temperatures up to 1000 deg. Fahr. 1000 w. Engng—June 25, 1909. No. 6280 A.

Steam Engines with Poppet Valves (Machines à Vapeur, Etude sur les Machines à Soupapes). E. Lefer. An explanation of their high steam consumption. Ills. 2000 w. Rev de Mécan—June, 1909. No. 6525 E + F.

Fuels.

Coal: What It Is and How It Was First Burned. Warren O. Rogers. Gives early experience with anthracite coal, and discusses its formation. Ills. 2000 w. Power—July 13, 1909. No. 6312.

Indicators.

See Steam Engines, under MARINE AND NAVAL ENGINEERING.

Smoke Prevention.

Smoke Prevention or Smoke Consumption. Harold V. Coes. Third and concluding paper of a series. Deals with the choice of apparatus for burning various grades of fuel, and with the application of automatic stokers to marine and locomotive service. Ills. 2500 w. Engineering Magazine—Aug, 1909. No. 6748 B.

The Prevention of Smoke. Wilfred Yorke. Remarks on the essentials of modern practice and the success of their applications. 1200 w. Elec Rev, Lond—July 2, 1909. No. 6293 A.

Stacks.

See same title, under CIVIL ENGINEERING CONSTRUCTION.

Steam Consumption.

The Steam Consumption in an Open Cooking Tank. G. Everett Quick. Illustrated report of tests made to determine the average quantity of steam used per pound of treated fat. 2000 w. Eng Rec—June 26, 1909. No. 6004.

Stoking.

Methods of Firing Soft and Hard Coal. William Kavanagh. Suggestions for firing and for cleaning the furnace. 1200 w. Elec Wld—July 1, 1909. No. 6109.

Turbine Operation.

Running a Westinghouse Steam Turbine. Explains important points of present-day practice. Ills. 2500 w. Power—July 13, 1909. Serial, 1st part. No. 6315.

Turbine Plants.

Remarkable Plant of the St. Clair Tunnel. Osborn Monnett. Illustrates and describes a turbine plant able to carry a load varying instantly from zero to 100 per cent. overload. 3500 w. Power—June 29, 1909. No. 6019.

Turbines.

Steam Turbines, from the Users' Point of View. Alfred S. Blackman. Read be-

fore the Incor. Munic. Elec. Assn. Statements regarding reliability and economy of impulse and reaction types; considering also equipments, economy and related matters. 3000 w. Mech Engr—June 25, 1909. No. 6270 A.

The Low-Pressure Steam Turbine. R. M. Neilson. An illustrated explanation of their efficiency and use. 4500 w. Power—July 6, 1909. No. 6200.

Low Pressure Steam Turbines. C. H. Smoot. Read before the N. E. L. A. Claims that turbines are not dependent on accurate workmanship for their reliability, and that simplicity and reliability go together. Explains the advantages of low-pressure turbines. Also editorial. Ills. 9500 w. Elec Age—June, 1909. No. 6132.

Willans Vacuum Turbine for Use with Exhaust Steam. Illustrated article dealing with the important points of an installation of this steam-turbine. 1800 w. Elec Engr, Lond—June 18, 1909. No. 6027 A.

The Melms-Pfenninger Steam-Turbine. Illustrated detailed description of an attempt to combine the advantages of both the impulse and reaction types of turbine, which seems to be successful. Plate. 2500 w. Engng—July 9, 1909. No. 6423 A.

Valves.

Types of Check Valve and Their Operation. W. H. Wakeman. Illustrates and describes the construction and operation of various types. 5000 w. Power—July 6, 1909. No. 6201.

TRANSPORTING AND CONVEYING.

Cableways.

Aerial Tramway for Coal Transportation. Robert M. Magraw. Illustrated description of plant at Electric, Mont. 3800 w. Mines & Min—July, 1909. No. 6178 C.

The Wetterhorn Cable Road of the Grindelwald Glacier, Switzerland. Frank Koester. Illustrated description of an installation of the Feldmann cable system, carrying tourists to a vertical height of 1377 feet. 1500 w. Elec Rev, N Y—July 10, 1909. No. 6210.

The Wetterhorn Cableway Incline. Illustrated description of this interesting cableway in Switzerland, and its operation. 1500 w. Eng News—July 22, 1909. No. 6616.

Passenger Cableway Carrier at Mt. Ulia, Spain. Illustrated description of a cableway connecting two mountain resorts. 600 w. Eng News—July 22, 1909. No. 6617.

A Passenger Ropeway at Mount Ulia, near Saint Sebastian, Spain (Le Transbordeur funiculaire à Voyageurs du Mont Ulia, près de Saint-Sébastien, Espagne). G. Espitallier. Brief illustrated description. 2000 w. Génie Civil—June 5, 1909. No. 6545 D.

Coal Handling.

Recent Developments in Conveying Machinery for Coal and Ashes. Wilbur G. Hudson. Second instalment of a discussion. Considers storage facilities, automatic weighing and ashes handling. Ills. 2500 w. Engineering Magazine—Aug, 1909. No. 6751 B.

The Virginian Railway's Coal Handling Plant. Illustrated description of the coal shipping terminal at Sewell's Point, Va. 1200 w. Ir Age—July 22, 1909. No. 6601.

Cranes.

Electric Travelling Gantry Crane. Illustrations with brief description. 500 w. Engng—June 18, 1909. No. 6041 A.

Grain Handling.

The Mitchell Cantilever Grain-Elevator. Illustrated detailed description of an elevator designed for discharging grain from ships to barges. 1600 w. Engng—July 9, 1909. No. 6424 A.

Hoists.

The Electric Hoist and Its Applications. Clifford F. Hutchings. Describes the construction and uses. Ills. 1200 w. Ind Engng—July 15, 1909. No. 6677 C.

Transporters.

A Novel Type of Transporter. Illustrated description of a conveyor of new design. 1000 w. Engr, Lond—June 18, 1909. No. 6051 A.

Electric Overhead Rack-Rail Transporter for Handling Meat. Illustrated description of Royce transporters for a plant at Buenos Aires, South America. 600 w. Sci Am Sup—July 24, 1909. No. 6623.

See also Cleaning, under MACHINE WORKS AND FOUNDRIES.

MISCELLANY.

Aeronautics.

Solution of Flight Problems by Graphical Methods. M. P. Logan. Deals with the problems of horizontal, and of rising and falling flight, developing a method believed to be of value to designers and engineers. 2000 w. Engr, Lond—July 16, 1909. No. 6688 A.

The Flight of the Curtiss Aeroplane for the Scientific American Trophy. Illustration, with account of the flight. 1200 w. Sci Am—July 24, 1909. No. 6622.

The Smallest Successful American Aeroplane. Illustrated description of the Curtiss machine and its operation. 2000 w. Am Mach—Vol. 32. No. 27. No. 6207.

Bleriot Aviates Across English Channel. Brief account of the trip and description of the monoplane. Ills. 1000 w. Automobile—July 29, 1909. No. 6777.

The Dirigible Balloon with Gyroscope Control. Russell Thayer. Briefly reviews the progress in aerial navigation and explains the author's application of the gyroscope to air navigation. Ills. 7000 w. Jour Fr Inst—July, 1909. No. 6353 D.

We supply copies of these articles. See page 1048.

The Record Flight of "Zeppelin II." Illustrated account of its accident, describing details. 1800 w. Sci Am Sup—July 3, 1909. No. 6092.

The 1908 Parseval Airship (Das Parsevalsche Motorluftschiff Model 1908). E. Rumpler. Illustrated description. 3000 w. Zeitsch d Ver Deutscher Ing—June 5, 1909. No. 6721 D.

Guns.

Recent Developments in Quick-Firing Field Guns. Illustrated descriptions of French, German and English recoil gears, and their advantages. 4000 w. Engr, Lond—June 25, 1909. No. 6285 A.

The Engineering of Ordnance. A. Trevor Dawson. The Gustave Canet lecture of the Junior Inst. of Engrs. The present number considers the influence of metallurgy on guns, and the influence of powders and explosive compounds on the ballistics of guns. Ills. 7000 w. Engng—July 2, 1909. Serial, 1st part. No. 6308 A.

Gyrostats.

Some Practical Aspects of Gyrostatic Action. W. S. Franklin. A discussion or explanation of gyrostatic action, giving formula for the calculation of torque-reaction due to precession. Ills. 4500 w. Pop Sci M—July, 1909. No. 6343 C.

Laundry Machinery.

Steel-Bed Ironing-Machine. Illustrated description of these machines. 1100 w. Engng—June 18, 1909. No. 6046 A.

Safety Devices.

Recent Safety Appliances on Carding Engines in Cotton-Mills. Illustrated descriptions of devices for the protection of carding-engines. 2500 w. Engng—June 25, 1909. No. 6279 A.

MINING AND METALLURGY.

COAL AND COKE.

Alberta.

The Coalfields of Alberta and Saskatchewan. Phillips Thompson. Gives an estimate of the coal available. 1200 w. Eng & Min Jour—July 3, 1909. No. 6167.

Blasting.

Shot Firers. P. Hanraty. Read before the Mine Inspectors' Inst. Conclusions from long experience in dangerous mines. 2200 w. Mines & Min—July, 1909. No. 6183 C.

Coke Ovens.

Genesis and Development of the Coking Oven. W. Galloway. Reviews the development, showing that the main features have not changed since 1860. Ills. 3000 w. Eng & Min Jour—July 3, 1909. No. 6165.

By-Product Coke Ovens. Abstract of information in regard to coke ovens, from a report of R. Forbes Carpenter. 2500 w. Col Guard—July 2, 1909. No. 6301 A.

The Koppers By-Product Coke Oven. Illustrated detailed description of two plants recently erected in England, explaining the special features of this system. 2000 w. Col Guard—July 2, 1909. No. 6300 A.

Huessener Waste Heat Coke Oven. Illustrated description of a typical installation of these coke ovens and by-product plants, stating their advantages. 2500 w. Col Guard—July 16, 1909. No. 6681 A.

The Pyrometry of the Beehive Coke Oven. J. R. Campbell. Read before the Coal Min. Inst. of Am. Describes devices used and methods employed in taking temperatures. 3000 w. Eng & Min Jour—July 17, 1909. No. 6393.

Coking By-Products.

Koppers Ammonia Sulphate Plant. Describes the main features of this new process, recently installed at the new coke plant at Gary, Ind. Ills. 4500 w. Pro Age—July 1, 1909. No. 6057.

Experiments with Gas Coals. J. Ferguson Bell. Abstract of a paper entitled "Carbonizing," read before the Inst. of Gas Engrs. A report of experiments to ascertain the effect of varying the weight and period of carbonization upon by-products. 2500 w. Ir & Coal Trds Rev—June 18, 1909. No. 6054 A.

Electric Power.

The Electrical and Coal Mining Industries. F. C. Albrecht. Abstract of a paper before the W. Va. Coal Min. Inst. Suggestions for the use of electricity in mines. 2000 w. Eng & Min Jour—July 24, 1909. No. 6642.

Safe Use of Electricity in Coal Mining. George R. Wood. Read before the Coal Min. Inst. of America. Suggestions as to proper voltage, insulation, etc. 3500 w. Eng & Min Jour—July 3, 1909. No. 6168.

Explosions.

Some Simple Causes of Mine Explosions. L. D. Tracy. Explains explosions due to the ignorance or carelessness of the human element, and to preventable causes. 2500 w. Eng News—July 1, 1909. No. 6082.

The Experimenting Station at Lievin, France. Tony Callot. Illustrated description of station for experimental research on the coal dust problem. 2500 w. Eng & Min Jour—July 3, 1909. No. 6163.

Explosives.

The Testing of Safety Explosives in the Experimental Gallery at Neunkirchen

We supply copies of these articles. See page 1048.

(Die Prüfung der Sicherheitsprengstoffe auf der Königlichen Versuchstrecke zu Neunkirchen bei Saarbrücken). Herr Hatzfeld. Describes the equipment and methods of testing and gives results. 4500 w. Glückauf—June 5, 1909. No. 6572 D.

Mine Ventilation.

The Regulation of Gas in Mine-Air Currents. John G. Smyth. Read before the W. Va. Coal Min. Inst. Reports investigations, the results of which may aid in eliminating coal-mine explosions. 2000 w. Eng & Min Jour—July 3, 1909. No. 6166.

Mining.

A Visit to an Anthracite Coal Mine. Warren O. Rogers. Illustrated description of methods of mining and timbering. 1500 w. Power—July 20, 1909. No. 6433.

Value of Efficient Engineering in Coal Mining. L. B. Abbott. Read before the W. Va. Coal Min. Inst. On the importance of system in laying out and equipping mines. 4000 w. Mines & Min—July, 1909. No. 6185 C.

Recovering Abandoned Coal Pillars. W. L. Hamilton. Early operators left 60 per cent of coal unmined, and the methods being made to extract this coal are described. 1500 w. Eng & Min Jour—July 3, 1909. No. 6169.

Coal Mining Methods at Gary, West Virginia. John S. Walker. Illustrated description of methods used in mines of the U. S. Steel Corporation, which claim to be the safest in the world. 1500 w. Eng & Min Jour—July 3, 1909. No. 6164.

Peat.

Investigations of the Peat Bogs and Peat Fuel Industry of Canada, 1908. Erik Nyström and S. A. Anrep. Describes the method of investigation, the peat bogs, and the present status of the industry. Ills. 6500 w. Can Dept of Mines—Bul No. 1. No. 30. No 6445 N.

Rescue Appliances.

The History of Breathing Apparatus in Mining (Die Vorgeschichte der Atmungsapparate im Bergbau). Fritz Jüngst. An illustrated review. Serial, 1st part. 6700 w. Glückauf—June 12, 1909. No. 6574 D.

Virginia.

Vast Coal Operations in the Clinchfield Region. William H. Stone. Information concerning the development of this large coal area. Map and illustrations. 4000 w. Mfrs' Rec—July 8, 1909. No. 6218.

Coal Mining in Southwestern Virginia. D. A. Patterson. Illustrated description of a mine equipped with modern devices for economic production. 1500 w. Can Min Jour—July 1, 1909. No. 6116.

West Virginia.

Presidential Address. J. B. Hanford. Address before the W. Va. Coal Min. Inst. on conditions affecting the mining business. 3000 w. Mines & Min—July, 1909. No. 6184 C.

Coal Mining in Central West Virginia. Floyd W. Parsons. Map and illustrated study of conditions and details of operation at the Coalton mine. 3000 w. Eng & Min Jour—June 26, 1909. No. 6010.

COPPER.

Alaska.

Mineral Resources of Kotsina-Chitina Region. Fred H. Moffit and A. G. Maddren. Abstract from Bul. 374, U. S. Geol. Surv. Describes the geography and gives the history of this copper region. 2500 w. Min Wld—July 17, 1909. No. 6410.

Mining on Prince of Wales Island, Alaska. W. A. Scott. An illustrated account of copper mines yielding some gold. 1600 w. Min & Sci Pr—June 26, 1909. No. 6058.

Arizona.

Ray Consolidated Mines. R. L. Herrick. Illustrates and describes a low-grade copper property at Ray, Ariz. 5000 w. Mines & Min—July, 1909. No. 6182 C.

Assaying.

Determination of Copper in Ores, Mattes, Etc. Richard K. Meade. Describes the three methods in common use—the electrolytic, the iodine, and the cyanide. Ills. 3000 w. Min Wld—June 26, 1909. No. 6005.

Australia.

The Cloncurry Copper District, Queensland. Gerard W. Williams. An illustrated account of a highly-mineralized but inaccessible region, where fuel and timber are scarce. 5000 w. Eng & Min Jour—July 24, 1909. No. 6640.

Wallaroo and Moonta Copper Mines and Smeltery. Gerard W. Williams. An illustrated description of South Australian mines which have been profitably worked for fifty years. 4500 w. Eng & Min Jour—July 10, 1909. No. 6246.

Jamaica.

The Copper Mines of Jamaica, British West Indies. Alexander E. Outerbridge, Jr. Illustrated account based mainly on personal observation. 1800 w. Engineering Magazine—Aug, 1909. No. 6752 B.

Matte Cars.

The Kilker Matte Tapping Car. F. T. Harvard. Illustrated description of a machine which makes possible a saving in the working costs of a smelting plant. 900 w. Eng & Min Jour—June 26, 1909. No. 6011.

Mexico.

The Cananea District. Describes this important copper camp. 3000 w. Ills. Min Wld—July 3, 1909. No. 6162.

Puebla. Describes especially the Teziutlan Copper Co.'s mines and smelter. Ills. 2500 w. Min Wld—July 3, 1909. No. 6157.

See also same title, under GOLD AND SILVER.

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Nevada.

See same title, under GOLD AND SILVER

Rolling Mills.

An Electrically-Operated Reversing Copper Rolling Mill. Dr. Alfred Gradenwitz. Illustrates and describes features of electric operation in connection with a rolling mill recently installed at Waldegg, Austria. 1200 w. Elec Rev, Lond—June 18, 1909. No. 6028 A.

Smelting.

High Silica Slags at the Magistral Smelter. C. A. Heberlein. Describes this smelter at Zacatecas, Mex., and its operation. 1500 w. Eng & Min Jour—July 17, 1909. Serial, 1st part. No. 6390.

Smelters.

The Tintic Smelter. Leroy A. Palmer. Describes the plan of construction, operation, machinery, and electrical equipment in use. Ills. 2800 w. Mines & Min—July, 1909. No. 6179 C.

GOLD AND SILVER.

California.

Geology of the Yellow Aster Mine, California. William H. Storms. Illustrated description of the geology and of the ore deposits in granite at Randsburg, that have produced about 6 million in gold. 3500 w. Eng & Min Jour—June 26, 1909. No. 6008.

Cobalt.

Operations in the Cobalt District, Ontario. Edwin Higgins. Illustrated article describing the geology, ore deposits, methods of mining and treatment. 3000 w. Eng & Min Jour—June 26, 1909. No. 6006.

See also Sampling, under ORE DRESSING AND CONCENTRATION.

Colorado.

Researches Upon the Telluride Gold Ores of Cripple Creek, Colo. Reports experiments carried out by the Portland Gold Mining Co. 2500 w. Jour Chem, Met & Min Soc of S Africa—May, 1909. No. 6673 E.

Ore-Deposition at Aspen, Colorado. J. Edward Spurr. A summary of the conditions of ore-deposition as interpreted by the writer. 7000 w. Ec-Geol—June, 1909. No. 6742 D.

Cyaniding.

Review of Modern Cyanide Practice in United States and Mexico. S. F. Shaw. Reviews the principal details in several modern plants. 8000 w. Bul Am Inst of Min Engrs—July, 1909. No. 6474 F.

See also Mexico, under GOLD AND SILVER.

France.

Gold Mining in France (Note sur les Mines d'Or en France). M. Strap. Read before the Congress of Applied Chemistry. A brief review of past and present activity. 1200 w. Rev de Métal—June, 1909. No. 6520 E + F.

India.

See same title, under LEAD AND ZINC.

Mexico.

Mexico. An account of the mining interests of the State of Mexico, surrounding Mexico City, especially the El Oro district. Ills. 3000 w. Min Wld—July 3, 1909. No. 6154.

Geological Formation of Mexico's Silver Mines. Albert F. J. Bordeaux. Describes the principal classes of deposits. Map. 1600 w. Min Wld—July 3, 1909. No. 6136.

Gold Mines in Chihuahua. W. D. Pearce. Reviews the history of gold mining and metallurgical methods, describing mines. Ills. 5000 w. Min Wld—July 3, 1909. No. 6146.

Chihuahua. George E. Griggs. Describes this state and its mineral deposits, reviewing the mining and metallurgy industries. Ills. 6500 w. Min Wld—July 3, 1909. No. 6144.

Sonora. Describes the mines of this region, which yield gold, silver, copper, zinc and lead. Ills. 3500 w. Min Wld—July 3, 1909. No. 6161.

Hidalgo. The state has vast mineral wealth, which has been mined since 1519. Illustrates and describes some of the mines. 3500 w. Min Wld—July 3, 1909. No. 6159.

Jalisco. Austin C. Brady. Map and description of the mining industry and matters related. Copper, gold, silver, etc., are found. Ills. 2000 w. Min Wld—July 3, 1909. No. 6156.

Guerrero. Sr. Ing. G. Ramonet. Describes the region which contains payable quantities of silver, gold and copper ores. Ills. 2500 w. Min Wld—July 3, 1909. No. 6160.

Zacatecas. Describes the mines which yield gold, silver, copper, and other values; the geology, ore deposits, etc. Ills. 6000 w. Min Wld—July 3, 1909. No. 6155.

Oaxaca. Paul Wooton. A report of present conditions of the mining industry, work in progress, railroad facilities, etc. Also The Geology of Oxaca, by A. E. Place. Ills. 7000 w. Min Wld—July 3, 1909. No. 6150.

The Santa Eulalia District. William Adams. Description, with review of the mineral deposits, mines, etc. Ills. 1500 w. Min Wld—July 3, 1909. No. 6145.

Durango. Reviews the history of this state, describing the mineral deposits, mines, etc. Ills. 2200 w. Min Wld—July 3, 1909. No. 6147.

The Velardena District. J. E. Spurr and G. H. Garrey. Describes this district, its mines and silver-lead-sulphide ores. 1200 w. Min Wld—July 3, 1909. No. 6148.

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Guanajuato. Illustrated description, with report of the mining and milling industries, and the production of gold and silver. 3000 w. Min Wld—July 3, 1909. No. 6151.

The La Luz District: D. F. Meiklejohn. A report of these rich silver mines. Gold is also recovered. 1200 w. Min Wld—July 3, 1909. No. 6152.

The Pozos District. W. F. Buchanan. A report of this camp and the silver and gold producing mines. 1500 w. Min Wld—July 3, 1909. No. 6153.

The Copala Region. J. Nelson Nevins. Illustrates and describes the Butters cyanide plant, which treats ores carrying about $1 in gold per each 10 oz. of silver. 2500 w. Min Wld—July 3, 1909. No. 6158.

Nevada.

The Lida Mining District of Nevada. W. A. Root. Map and illustrated description of mines yielding gold, silver, lead, and copper ores. 1500 w. Min Wld—July 10, 1909. No. 6261.

Discovery of the Great Comstock Mine. Dan De Quille. Abstract account from "The Great Bonanza." 2000 w. Min & Sci Pr—July 3, 1909. No. 6197.

Comstock Beginnings. Joseph T. Goodman. An illustrated account of this great mine in which silver was discovered fifty years ago. 2500 w. Min & Sci Pr—July 3, 1909. No. 6196.

New Mexico.

Revival of Mining in the Mogollons, New Mexico. E. Gybbon Spilsbury. Illustrated description of a remote mining region where the low-grade gold and silver ore becomes richer with depth. 3000 w. Eng & Min Jour—July 10, 1909. No. 6247.

Ontario.

The Gowganda and Miller Lakes Silver Area. A. G. Burrows. Abstracts from 18th An. Rept. of Ontario Bureau of Mines. Gives plan of surveyed claims, with information. 2500 w. Min Wld—July 17, 1909. No. 6411.

South Lorrain Silver Area. A. G. Burrows. Abstract of a report describing this field in Ontario and the discoveries made. Map. 3000 w. Can Min Jour—July 15, 1909. No. 6407.

Patio Process.

History and Development of the Patio Process. C. Perez Duarte. An illustrated review, with a study of the reactions 4000 w. Min Wld—July 3, 1909. No. 6137.

Placers.

Some Ore Deposits Connected with Placers. Matt. W. Alderson. Describes peculiarities of ore deposits that are often misleading. 2500 w. Min Wld—July 24, 1909. No. 6658.

Notes on Manhattan Placers, Nye County, Nev. Charles Coleock Jones. Notes on the formation, ore deposits and related subjects. Ills. 2000 w. Eng & Min Jour—July 17, 1909. No. 6388.

Placer Examinations. Arthur Lakes, Jr. Explains method of prospecting with churn drills, collecting and panning samples, estimating and recording results. 3000 w. Mines & Min—July, 1909. No. 6181 C.

Rhodesia.

Gatooma, a Rich Rhodesian Field. Owen Letcher. Describes a promising small mine area. 800 w. Min Wld—July 17, 1909. Serial, 1st part. No. 6409.

IRON AND STEEL.

Analysis.

Determining Carbon in Steel. Warren I. Keeler. Illustrated description of a successful direct combustion apparatus, unsurpassed for speed and accuracy. 2500 w. Ir Age—July 22, 1909. No. 6604.

The Application of the Rothe Process to the Analysis of Iron Minerals and Iron Products (Application du Procédé Rothe à l'Analyse des Minerais de Fer et des Produits sidérurgiques). L. Campredon. Read before the Congress of Applied Chemistry. 1200 w. Rev de Métal—June, 1909. No. 6521 E + F.

Check Analyses of Iron Ore (Schiedsanalysen). Discusses several examples of lack of correspondence in ore analyses made in different laboratories. 2500 w. Stahl u Eisen—June 9, 1909. No. 6563 D.

Blast Furnaces.

Designing Blast Furnaces. M. Pavloff. Gives data from experience and personal knowledge and shows the application of these data to the designing of blast furnaces working under different conditions. 7500 w. Ir & Coal Trds Rev—July 9, 1909. No. 6431 A.

Dry-Air Blast.

The Gayley Dry Air Blast. Report of the Franklin Institute through its Committee on Science and the Arts. 2000 w. Jour Fr Inst—July, 1909. No. 6356 D.

Electro-Metallurgy.

The Efficiency of Induction Furnaces. Joh. Härdén. Gives particulars of results obtained in a 60-kw experimental induction furnace, with a few explanations and comparisons. 2500 w. Elec-Chem & Met Ind—July, 1909. No. 6195 C.

Methods of Refining Steel in the Electric Furnace. John B. C. Kershaw. Deals with arc and induction electric processes for making high-grade steels. Ills. 2500 w. Cassier's Mag—July, 1909. No. 6345 B.

Electric Furnaces as Applied to the Manufacture of Iron and Steel. Ch. A. Keller. Abstract of paper before the Faraday Soc. Illustrated descriptions of the construction and performances of various types. 3500 w. Elect'n, Lond—July 2, 1909. No. 6294 A.

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A Contribution to the Study of Electric Furnaces as Applied to the Manufacture of Iron and Steel. Ch. A. Keller. Abstract of a paper before the Faraday Soc. A report of researches and personal work. Ills. 5800 w. Ir & Coal Trds Rev—June 18, 1909. No. 6053 A.

Automatically Circulating Furnaces of the Gin Type for the Electrical Production of Steel. Gustave Gin. Abstract of a paper read before the Faraday Soc. Illustrated description. 1500 w. Ir & Coal Trds Rev—June 18, 1909. No. 6056 A.

Steel Making in the Electric Furnace (Etat actuel de la Fabrication de l'Acier au Four électrique). Ch. Clausel de Coussergues. Read before the Congress of Applied Chemistry. An exhaustive discussion of the present state of the art, with descriptions of the principal electric steel works. Ills. 40000 w. Rev de Métal—June, 1909. No. 6507 E + F.

Electric-Furnace Electrodes (L'Ame du Four électrique, l'Evolution de l'Electrode). Isidore Bay. A sketch of the development of the electric furnace, and particularly of the electrodes. Serial, 1st part. 2000 w. L'Elecn—June 5, 1909. No. 6534 D.

Ferro-Alloys.

Ferro-alloys (Les Alliages ferrométalliques). M. Chaplet. Read before the Congress of Applied Chemistry. A summary of their properties and methods of preparation. 4000 w. Rev de Métal—June, 1909. No. 6513 E + F.

Ingots.

Notes on Tests of Ingots and Derivative Shapes in Progress at Watertown Arsenal. James E. Howard. Read before the Am. Soc. for Test. Mat. Tests to obtain information on the causes which produce unsoundness. Ills. 1000 w. Ir Trd Rev—July 8, 1909. No. 6206.

Rolling Mills.

Power Requirements for Rolling High-Carbon Steel of Small Section. Brent Wiley. A report of tests. 500 w. Pro Am Inst of Elec Engrs—July, 1909. No. 6486 F.

Recent Developments at the Works of the Pather Iron and Steel Company, Limited. Illustrates and describes the new electrically-driven rolling mill recently erected at Wishaw, N. B. 2500 w. Ir & Coal Trds Rev—June 25, 1909. No. 6288 A.

Electrically Driven Reversing Ingot Roll Train of the Rhine Steelworks, Duisburg-Meiderich (Die elektrisch betriebene Umkehrblochstrasse der Rheinischen Stahlwerke). Georg Meyer. Illustrated detailed description. 7700 w. Stahl u Eisen—June 9, 1909. No. 6564 D.

Sheets.

See Cleaning under MECHANICAL ENGINEERING, MACHINE WORKS AND FOUNDRIES.

Steel Works.

The Friedenshütte Works. Illustrated description of large works in Germany. Translated from *Stahl und Eisen*. 4000 w. Ir & Coal Trds Rev—July 16, 1909. No. 6694 A.

The Plants of the Upper Silesia Railway Equipment Company, Friedenshütte (Die Anlagen der Oberschlesischen Eisenbahn-Bedarfs-A.-G. zu Friedenshütte). Illustrated detailed description of a very extensive plant. 6500 w. Stahl u Eisen—June 23, 1909. No. 6567 D.

Texas.

Iron Ores of Llamo County, Texas. William B. Phillips. Information concerning the iron ore deposits. 2000 w. Mfrs' Rec—July 15, 1909. No. 6317.

LEAD AND ZINC.

India.

The Silver-Lead Mines of Bawdwin, Northern Shan States. T. D. La Touche and J. Coggin Brown. Abstracted from the records of the Geol. Surv. of India. Describes the location, mode of occurrence, and metallurgy. 3000 w. Min Jour—July 10, 1909. No. 6608 A.

Lead Smelting.

Lead Smelting and Refining Practice at Trail, B. C. Describes the treatment of these sulphide ores. 1500 w. Can Min Jour—July 15, 1909. Serial, 1st part. No. 6408.

Mexico.

Development of Zinc Mining Industry in Mexico. The northern district is reviewed by Philip C. Hanna; the central district by Thomas W. Voetter; the northwest district by Lewis A. Martin. 4000 w. Min Wld—July 3, 1909. No. 6141.

The Mapimi District. J. D. Villarello. Describes the ore deposits. The most abundant primary minerals are mispickel, galena, blende and iron pyrite with calcite as the gangue. The precious metals are irregularly distributed. Ills. 1200 w. Min Wld—July 3, 1909. No. 6149.

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Nevada.

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Zinc Smelting.

A Revolving Retort for Volatilizing Zinc Ores. H. H. Hughes. Explains the aim of the revolving retort and gives illustrations and description. 2000 w. Min Wld—July 10, 1909. No. 6262.

MINOR MINERALS.

Barium.

Barium (Ba) Ores. E. B. Wilson. Where found, uses, and methods of preparation of barité. 2200 w. Mines & Min—July, 1909. No. 6180 C.

Clay.

Clay Mining and Its Relation to Coal Mining. Richard R. Hice. Read before the

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Coal Min. Inst. of Am. Discusses methods and reasons why the industry has generally proved unprofitable. 3000 w. Eng. & Min Jour—July 17, 1909. No. 6389.

Diamonds.

Does an Australian Kimberley Exist? John Plummer. Reviews what is known of the diamond-bearing regions of Australia. 1000 w. Min & Sci Pr—July 17, 1909. No. 6627.

Mercury.

Shortening the Roasting Period for Mercury Ores. William B. Dennis. Describes improvements in roasting low-grade mercury sulphide ore at Blackbutte, Ore. Ills. 4000 w. Eng & Min Jour—July 17, 1909. No. 6392.

Monazite.

Monazite Occurrence and Mining in the Carolinas. Joseph Hyde Pratt and Douglas B. Sterrett. Abstract from Bul. U. S. Geol. Surv. Illustrated description. 5000 w. Min Wld—July 24, 1909. No. 6656.

Natural Gas.

Field Operations in Natural Gas. William McNair Welsh. Read before the Nat. Gas Assn. Discusses the supply, flow through pipes, wells, etc. 3500 w. Am Gas Lgt Jour—July 5, 1909. No. 6101.

Oil.

The Steel Oil Derrick. R. B. Woodworth. Reviews briefly the history of the petroleum industry, the production, the geological conditions affecting the depth of wells, types of well-drilling mechanism, the loads on the derrick and machinery, stresses, and the complete drilling machine of 1909 design. Ills. Discussion. 17500 w. Pro Engrs' Soc of W Penn—June, 1909. No. 6375 D.

Economic Possibilities of American Oil Shales. Charles Baskerville. Information concerning this industry both abroad and in America. The by-products often pay entire expense. Ills. 4500 w. Eng & Min Jour—July 24, 1909. Serial, 1st part. No. 6639.

Principal Petroleum-Bearing Regions of Mexico. Juan D. Villarello. A summary of a recent study of these regions. 6000 w. Min Wld—July 3, 1909. No. 6143.

Problems of the Russian Oil Industry. Frank Richards. Explains conditions at Baku, Russia. 1700 w. Eng & Min Jour—July 10, 1909. No. 6249.

Phosphate.

Phosphate Deposits of United States. Frank B. Van Horn. Gives location and description of the principal deposits known. Maps. 1800 w. Min & Sci Pr—July 17, 1909. No. 6626.

Precious Stones.

Gems and Precious Stones of Mexico. George F. Kunz. Information concerning their occurrence, and what is known of the different gems reported. 4500 w. Min Wld—July 3, 1909. No. 6139.

Quicklime.

The Influence of Moist Air on Quicklime. Jas. Gray. Brief account of experiments and conclusions. 700 w. Jour Chem, Met & Min Soc of S Africa—May, 1909. No. 6672 E.

Salt.

Refining Salt from the Great Salt Lakes, Utah. Leroy A. Palmer. Illustrated description of a system of pneumatic concentration. 1500 w. Min Wld—July 24, 1909. No. 6657.

Tin.

The Origin of the Bolivian Tin Deposits. William R. Rumbold. Aims to show that the popular idea of the origin of these deposits is erroneous, and that the majority of the deposits may be attributed to the same causes which have produced the other tin deposits of the world. Ills. 8000 w. Ec-Geol—June, 1909. No. 6743 D.

The Tin Mines of Llallagua, Near Oruro, Bolivia. Augusto Endter. Abstract translation describing the geology, vein structure and mining. 1500 w. Min Jour—July 10, 1909. No. 6609 A.

MINING.

Caving System.

Change of Method in Mining Soft Ore. Stuart Rhett Elliott. Describes the conditions and the caving system of mining adopted. Ills. 1500 w. Min & Sci Pr—July 17, 1909. No. 6628.

Drainage.

Comstock Drainage Problems. Leon M. Hall. A review of past and present equipment. Ills. 2200 w. Min & Sci Pr—July 3, 1909. No. 6199.

The Comstock Mines To-day. Whitman Symmes. An illustrated explanation of the present policy being pursued in unwatering the mines. 1500 w. Min & Sci Pr—July 3, 1909. No. 6198.

Earth Settlement.

See Track Construction, under STREET AND ELECTRIC RAILWAYS.

Explosives.

Report to the International Commission on the Unification of the Methods of Testing the Stability of Explosives. V. Watteyne and S. Stassart. From report presented to the Congress of Applied Chemistry. 1600 w. Col Guard—July 9, 1909. No. 6421 A.

Hoisting Engines.

The Mechanics of Ilgner-Operated Winding-Engines. Considers advantages of electrical operation of rolling-mill plants and winding-engines, and explains the scheme of operation. 2200 w. Engng—June 18, 1909. No. 6039 A.

Electric Hoisting Equipment at Winona, Mich. R. R. Seeber. Illustrated description of Ilgner fly-wheel motor generator set, with Ward Leonard control. 1500 w. Eng & Min Jour—July 17, 1909. No. 6391.

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An Electrically Operated Hoisting Plant. A. Gradenwitz. Illustrated description of a scheme devised to eliminate the fly-wheel converter. 1500 w. Eng & Min Jour—July 10, 1909. No. 6251.

Hydraulic Filling.

See same title, under CIVIL ENGINEERING, CONSTRUCTION.

Laws.

Synopsis of the New Mining Laws of Mexico. M. C. Little. A digest of the new bill recently passed. 5000 w. Min Wld—July 3, 1909. No. 6142.

Mine Maps.

The Importance of Proper Underground Maps. Thomas E. Fisher. Suggestions for making accurate maps of underground workings. Ills. 2000 w. Min Wld—July 10, 1909. No. 6260.

Mine Temperature.

The Relation between the Temperatures of Rock and Air (Zusammenhang zwischen Gesteins- und Wettertemperaturen). Ernst Schmid. A theoretical discussion. Ills. Serial, 1st part. 2200 w. Oest Zeitschr f Berg u Hüttenwesen—June 5, 1909. No. 6569 D.

Pumping.

Pumping Plant at the Tombstone Consolidated. Elton W. Walker. Illustrated description of a plant for pumping a mine where the daily flow averaged over 5,000,000 gallons. 1800 w. Eng & Min Jour—July 24, 1909. No. 6641.

Water Columns for Deep Level Mines. E. J. Laschinger. Formulates expressions giving the average cost of water columns for depths up to 2000 ft. vertical, in terms of the diameter, and of transmission losses. 1500 w. Jour S African Assn of Engrs—May, 1909. No. 6025 F.

Safety.

On the Relation of Safety to Economy in Mining. Malcolm Fergusson. Deals especially with the importance of careful supervision for both efficiency and safety. Discussion. 4000 w. Jour S. African Assn of Engrs—May, 1909. No. 6024 F.

Skips.

Automatic Dumping Skip for Vertical Shafts. George C. McFarlane. Illustrates and describes a self-dumping skip for hoisting either rock or water. 2000 w. Eng & Min Jour—June 26, 1909. No. 6009.

Surveying.

Stope Measurements. Otto S. Tonnesen. States some of the objections to methods employed, and describes an improved method. Ills. 8000 w. Jour Chem, Met & Min Soc of S. Africa—May, 1909. No. 6671 E.

Survey to Fix Position of the Water Haigh Pits. G. R. Thompson. Read at Yorkshire meeting of the Nat. Assn. of Col. Mgrs. Describes the methods of conducting the survey. Ills. Discussion. 4500 w. Ir & Coal Trds Rev—July 2, 1909. No. 6311 A.

Timbering.

See Mining, under COAL AND COKE.

ORE DRESSING AND CONCENTRATION.

Calculations.

Calculations in Ore Concentration. Full abstract of a paper by Dr. Rudolf Gahl, before the Colo. Sec. of W. Assn. of Tech. Chem. & Met. Discusses simple mathematical calculations as a means of getting practical information from screen tests and assays. 3500 w. Elec-Chem & Met Ind—July, 1909. No. 6192 C.

Filtration.

Vacuum Slime-Filters at Goldfield. Alfred Merritt Smith. Describes the evolution of filter work at Goldfield. 1000 w. Min & Sci Pr—July 10, 1909. No. 6320.

Gold Milling.

Visit to Simmer Deep, Ltd. Illustrated description of reduction works for the treatment of gold ores of South Africa. 3000 w. Jour Chem, Met & Min Soc of S Africa—May, 1909. No. 6674 E.

Mixed Sulphides.

The I. R. Process in Cornwall. Describes this process, its advantages, and the results obtained with complex sulphides. 1400 w. Min Jour—July 17, 1909. No. 6662 A.

Pneumatic Concentration.

See Salt, under MINOR MINERALS.

Sampling.

Sampling of Cobalt Ores. Albert R. Ledoux. Describes the methods of sampling and ore treatment. 2000 w. Can Min Jour—July 1, 1909. No. 6115.

Silver Milling.

Pittsburg Silver Peak Mill. Henry Hanson. Illustrated description of the surface plant and processes in use at the mill at Blair, Nevada. 4500 w. Mines & Min—July, 1909. No. 6186 C.

Treating Low-Grade Refractory Ores of Mexico. Mark R. Lamb. An account of present practice and the need of cheapening costs. Ills. 3500 w. Min Wld—July 3, 1909. No. 6135.

Stamp Mills.

The Proper Design of Cams. Mark R. Lamb. Considers the important features of stamp-mill cam design, the strains, and related matters. 1500 w. Eng & Min Jour—July 10, 1909. No. 6248.

Tailings Disposal.

Tailings Disposal Plant at the Wolverine Mill. C. Kemble Baldwin. Illustrated description of plant at Gay, Michigan, for disposal of copper tailings. 2000 w. Eng & Min Jour—July 10, 1909. No. 6250.

Zinc Milling.

Mechanical Preparation of Ores in Sardinia (Die mechanische Aufbereitung der

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Erze in Sardinien). E. Ferraris. Brief description of the apparatus and methods used. Ills. 3500 w. Oest Zeitschr f Berg u Hüttenwesen—June 26, 1909. No. 6571 D.

The New Blende Concentrating Works at the "Neue Helene" Zinc-Lead Mine at Scharley, Upper Silesia (Die neue Blendeaufbereitungsanlage des Zink-und Bleierzbergwerks "Neue Helene" bei Scharley, Oberschlesien). Herr Piegza. Detailed description of the equipment of this large mill. Ills. 3000 w. Glückauf—June 5, 1909. No. 6573 D.

MISCELLANY.

Atomic Weights.

An Outline of a New Practical Method for the Calculation of Atomic Weights. Dr. Gustavus D. Hinrichs. Claims that the official atomic weights of the Am. Chem. Soc. are not true to nature, and outlines the author's theory. Also editorial. 4000 w. Elec-Chem & Met Ind—July, 1909. No. 6194 C.

Bolivia.

Mining Conditions in Bolivia. J. Wilson Williams. Information concerning the minerals, mining regulations, and mining industry. 2000 w. Min Jour—June 26, 1909. No. 6272 A.

Calcium Sulphate.

The Behavior of Calcium Sulphate at Elevated Temperatures with Some Fluxes. H. O. Hofman and W. Mostowitsch. Postscript to a paper published in the Jan. Bulletin giving a new investigation of the decomposition of ferric oxide by heating in dry air. 400 w. Bul Am Inst of Min Engrs—July, 1909. No. 6475 F.

England.

Presidential Address of James Charles Inglis. Deals principally with transport and the relation of engineering. Specially reviewing the railway conditions of the United Kingdom. Appendices. 11500 w. Inst of Civ Engrs—Nov. 3, 1908. No 6446 N.

Haiti.

The Mineral Resources of Haiti, West Indies. Edw. G. W. Ferguson. Reviews the early history to explain the slow development of this island, and gives brief descriptions of the known deposits. 4000 w. Min Wld—July 10, 1909. No. 6263.

Mexico.

Physical and Geological Features of Mexico Mining. Ezequiel Ordonez. Description, with explanation of the six types of ore deposits that include the great producers of gold, silver, copper, lead, zinc, antimony and tin. 1500 w. Min Wld—July 3, 1909. No. 6138.

New York.

The Mineral Production of New York in 1908. D. H. Newland. Gives statistics, showing the effect of the financial depression. 1600 w. Eng & Min Jour—June 26, 1909. No. 6007.

Ore Deposits.

Metallogenetic Epochs. Waldemar Lindgren. Read before the Can. Min. Inst. A critical examination of mineral deposits and the principal epochs of the segregation of metals in North America. 4000 w. Can Min Jour—July 15, 1909. No. 6406.

The Formation and Enrichment of Ore-Bearing Veins. George J. Bancroft. Supplementary to a paper read April, 1907, giving results of further study. 3300 w. Bul Am Inst of Min Engrs—July, 1909. No. 6473 F.

Interesting Little Black Dikes. Arthur Lakes. Describes igneous rock found associated with rich ore deposits in Idaho and other places. 1500 w. Min Wld—July 24, 1909. No. 6655.

Garnet Contact Deposits of Copper and the Depths at Which They Are Formed. Charles R. Keyes. A study of the conditions producing garnetization. Ills. 2500 w. Ec-Geol—June, 1909. No. 6744 D.

Refractory Materials.

Refractory Materials (Les Produits réfractaires). Louis Baraduc-Muller. Read before the Congress of Applied Chemistry. A general discussion, results of researches and a detailed consideration of the principal classes. 1500 w. Rev de Métal—June, 1909. No. 6510 E + F.

Researches on the Conductivity, Porosity, and Permeability of Refractory Materials (Recherches sur la Conductibilité, la Porosité et la Perméabilité des Matières réfractaires). S. Wologdine. Read before the Congress of Applied Chemistry. A report of extended investigations. Ills. 15000 w. Rev de Métal—June, 1909. No. 6515 E + F.

RAILWAY ENGINEERING.

CONDUCTING TRANSPORTATION.

Accidents.

American Railway Accidents. Gives statistics for the years 1907 and 1908, and quotes comments of Interstate Commerce Commission. 1500 w. Engr, Lond—June 18, 1909. No. 6049 A.

The Crawford Derailment. Discusses this accident and also Colonel Yorke's report upon it. 1500 w. Engr, Lond—July 2, 1909. No. 6310 A.

Derailments.

A Study of the Stability of Railway Rolling Stock (Etude complémentaire sur

We supply copies of these articles. See page 1048.

la Stabilité du Matériel des Chemins de Fer). Georges Marié. Presents a complete theory of derailments and a discussion of its importance in connection with the design of tire profiles. Ills. 14000 w. Mem Soc Ing Civ de France—May, 1909. No. 6502 G.

Despatching.

The Train Despatcher's Status. J. F. Mackie. From a paper read at Columbus meeting of the Train Des. Assn. Brief review of the development of the service with the increase in traffic. 1500 w. R R Age Gaz—July 16, 1909. No. 6380.

Signalling.

First Annual Report of the Block Signal and Train Control Board to the Interstate Commerce Commissions. Ills. 38000 w. Bul Int Ry Cong—June, 1909. No. 6459 G.

The Use of Alternating Currents in Railway Signaling. W. K. Howe. Read before the Ry. Sig. Assn. Explains the advantages as compared with direct current, illustrating the use of the A. C. track circuit as applied to electric traction roads. 3000 w. R R Age Gaz—July 9, 1909. Serial, 1st part. No. 6236.

The Resistances and the Application of Double-Wire Transmissions for Operating Switches and Signals at a Distance. L. H. N. Dufour. Particulars as to resistance to movement of the different switches and signals, and of parts of a wire-transmission system, discussing possible improvements. 9000 w. Bul Int Ry Cong—June, 1909. No. 6458 G.

Interlocking and Signalling. E. W. Oliver. Considers in detail some of the conditions of interlocking and signalling required at grade crossings of railways in Canada. Ills. 7500 w. Can Engr—July 30, 1909. No. 6786.

Automatic Block Signals. W. B. Kouwenhoven. Considers the operation of block signals on double-track roads only. 2000 w. Ry & Loc Engng—July. 1909. No. 6121 C.

The Ciraolo Distant-Control Signal (Nota sul Sistima di Disco manovrato a Distanza inventato dall-Ing. Ciraolo). Ferruccio Celeri. An exhaustive description. Ills. 6500 w. Ing Ferro—June 1, 1909. No. 6555 D.

MOTIVE POWER AND EQUIPMENT.

Air Brakes.

The Question of the Proposed Trials of Goods-Train Brakes. A. Huberti and J. Doyen. Gives details of certain points relating to brake trials with continuous brakes. 4000 w. Bul Int Ry Cong—June, 1909. No. 6457 G.

Leaky Graduating Valve. Explains the action of a leaky graduating valve, and methods of testing. 2500 w. Ry & Loc Engng—July, 1909. No. 6120 C.

Car Haulage.

Mechanical Car Haulage, a Collecting-Yard Novelty (Machinelle Wagen-Rangieranlagen, eine Neuerung für den Verschiebedienst). Herr Peter. Describes a system of endless wire-rope haulage for shifting railway cars about a yard. Ills. 3200 w. Glaser's Ann—June 1, 1909. No. 6587 D.

Electrification.

The Difficulties of Underground Transmission for Trunk Line Electrification. William A. Delmar. An examination of construction and operation difficulties in underground transmission. 1500 w. Elec Age—June, 1909. No. 6131.

Electric-Traction Studies in Switzerland (Gli Studii per la Trazione elettrica in Svizzera). Emilio Gerli. A *résumé* of the results of recent extended investigations. Serial, 1st part. 3500 w. Ing Ferro—June 1, 1909. No. 6556 D.

Fuel Accounting.

Best Method of Accounting for Railway Fuel. Extracts from report of committee before the Int. Ry. Fuel Assn. 3000 w. Ry & Engng Rev—June 26, 1909. No. 6014.

Locomotive Boilers.

Advisability of Installing Hot-Water Washouts and Filling Systems Luther H. Bryan. Read before the Int. Ry. Gen. Foremen's Assn. Presents the advantages of the hot-water system. 1200 w. Boiler Maker—July, 1909. No. 6188.

Locomotive Brakes.

The Pressure on Locomotive Brake Blocks. Considers methods of estimating the pressure. Diagrams. 2000 w. Engr, Lond—July 9, 1909. No. 6427 A.

Locomotive Construction.

Locomotive Construction in the United States, Germany and France (Note sur la Construction des Locomotives aux Etats-Unis, en Allemagne et en France). Louis Le Chatelier. A criticism of M. Marcel Bloch's paper on this subject. 2000 w. Rev Gen des Chemins de Fer—June, 1909. No. 6531 G.

Locomotive Life.

On the Serviceable Life and Average Annual Cost of Locomotives in Great Britain. Richard Price Williams. Deals with the locomotive stock of 15 of the principal railways in Great Britain. Tables and diagrams. 4500 w. Inst of Civ Engrs—No. 3766. No. 6449 N.

Locomotive Management.

Fuel Economies. From a committee report to the Am. Ry. Mas. Mech. Assn. Practical suggestions. 4000 w. Ry & Engng Rev—June 26, 1909. No. 6015.

Fuel Economies on the Locomotive. Portion of a committee report at convention of the Am. Ry. Mas. Mech's Assn. Deals with essential conditions. 2500 w. Eng News—July 1, 1909. No. 6087.

We supply copies of these articles. See page 1048.

Locomotive Performance.

Locomotive Performance Under Saturated and Superheated Steam. Extracts from a paper by W. F. M. Goss, before the Am. Ry. Mas. Mech. Assn. A report of tests and methods. 6000 w. Ry & Engng Rev—June 26, 1909. No. 6013.

Locomotive Repairs.

A Firebox Patch. J. P. Morrison. Read before the Int. Ry. Gen. Foremen's Assn. Describes work requiring great care, giving itemized account of cost. 2000 w. Boiler Maker—July, 1909. No. 6189.

Locomotives.

The Earliest Balanced Locomotives. Herbert T. Walker. Illustrated description of the designs of John George Bodmer, in 1834, are given in the present number. 1500 w. R R Age Gaz—July 23, 1909. Serial, 1st part. No. 6631.

A Tabular Comparison of Notable Examples of Recent Locomotives Arranged in Order of Total Weights. 3000 w. Am Engr & R R Jour—July, 1909. No. 6190 C.

Mikado Locomotives for the Chicago, Milwaukee & Puget Sound. Illustrated description of a design for 20 recently completed locomotives. 500 w. R R Age Gaz—July 16, 1909. No. 6378.

Recent C. & A. Equipment. Illustrations, with descriptions, of locomotives for heavy frieght and for fast passenger service. 1500 w. Ry & Loc Engng—July, 1909. No. 6118 C.

Consolidation Locomotives for the Pennsylvania. Illustrates and describes an example of Class H-8b, interesting on account of their weight, tractive power, and details of bracing. 500 w. R R Age Gaz—July 2, 1909. No. 6126.

Ten-Wheel Tank Locomotive (3-ft. 6-in. Gauge); Dutch Indian Railway. Illustrated detailed description of engines recently put in service in Java. Plate. 1200 w. Engng—June 18, 1909. No. 6042 A.

Four-Cylinder Pacific Compound of the Orleans Railway (Locomotives Pacific compound à quatre Cylindres de la Compagnie d'Orléans). Illustrated description. 3200 w. Génie Civil—June 19, 1909. No. 6548 D.

Motor Cars.

The Petrol-Electric System of Traction. Illustrates and describes this system of motor-car traction on the Continent, as installed by the Westinghouse Co. 2000 w. Tram & Ry Wld—July 8, 1909. No. 6606 B.

Suburban Operation with Accumulator Motor Cars on the Prussian State Railways (Vorortverkehr mit elektrischen Triebwagen auf den Preussichen Staatsbahnen). Carl Vogel. Describes the cars, their equipment, and operating results. Ills. 4500 w. Elek Kraft u Bahnen—June 23, 1909. No. 6713 D.

Passenger Cars.

Coach with Steel Underframes for the Central of New Jersey. Illustrated description. 500 w. R R Age Gaz—July 9, 1909. No. 6233.

Tonnage Rating.

The Effect of the Physical Characteristics of a Railway upon the Operation of Trams. From Bul. 112 of the Am. Ry. Engng. & Main. of Way Assn. Gives formulae and methods for tonnage rating and for comparing projected lines. 1000 w. R R Age Gaz—July 16, 1909. Serial, 1st part. No. 6381.

Train Ferries.

A New Railway Train Ferry Service. An illustrated account of the new service between Germany and Sweden. 1500 w. Engr, Lond—July 16, 1909. Serial, 1st part. No. 6690 A.

Train Lighting.

Compressed Gas and Electric Car Lighting. George L. Fowler. An investigation of the present status of the car-lighting problem and the cost. 5000 w. R R Age Gaz—July 9, 1909. No. 6235.

Axle-Driven Head-End Electric Train Lighting System. Illustrated description of the system worked out by W. J. Bohan. Ills. 1500 w. R R Age Gaz—July 9, 1909. No. 6238.

Wheels.

Car Wheels. Extracts from report of Committee of the Master Car Builders' Assn. Ills. 5000 w. Ry & Engng Rev—July 10, 1909. No. 6265.

PERMANENT WAYS AND BUILDINGS.

Construction.

The Davos-Filisur Railway (Die Bahnlinie Davos-Filisur). P. Saluz. Describes the construction of an extremely difficult mountain line in Switzerland. Ills. Serial, 1st part. 1700 w. Schweiz Bau—June 5, 1909. No. 6578 B.

Curves.

Easement Curves (Uebergangskurven und deren Anschluss an die Bahnkrümmungen). E. Haunold. Mathematical discussion of the calculation of transission ends with tables of data. Ills. 3500 w. Zeitschr d Oest Ing u Arch Ver—June 11, 1909. No. 6595 D.

Rails.

Specifications for 90-lb. Bessemer and Open Hearth Steel Rails for the Harriman Lines. Gives specifications to which the 1909 orders are purchased. 1500 w. R R Age Gaz—July 30, 1909. No. 6780.

Dark Carbon Streaks in Segregated Metal in Split Heads of Rails. Dr. P. H. Dudley. Read before the Am. Soc. for Test. Mat. Illustrated report of investigations. 2500 w. Ry & Engng Rev—July 10, 1909. No. 6264.

Rail Failures Due to Burns and Crystallization, Caused by Slipping of Engine Drivers, Baltimore & Ohio Railroad. A.

We supply copies of these articles. See page 1048.

W. Thompson. From Bul. 111 of the Am. Ry. & Main. of Way Assn. Gives analyses of rails causing derailments, showing the weakening. Ills. 2000 w. Can Engr—July 23, 1909. No. 6638.

See also Steel Specifications, under CIVIL ENGINEERING, MATERIALS OF CONSTRUCTION.

Reconstruction.

The Widening of Wemyss Bay Railway. Illustrated detailed description of interesting work to meet conditions of congested traffic on the shores of the Firth of Clyde. Plates. 4500 w. Engng—July 2, 1909. Serial, 1st part. No. 6303 A.

Roundhouses.

See Reinforced Concrete, under CIVIL ENGINEERING, CONSTRUCTION.

Sanitation.

Railway Sanitation. Dr. J. N. Hurty. Discusses matters relating to the care of cars, stations and railway roadbeds. 1500 w. R R Age Gaz—July 9, 1909. No. 6234.

Terminals.

The New Terminal Station, Birmingham, Ala. P. Thornton Marye. Illustrated description. Plates. 2000 w. Am Archt—July 14, 1909. No. 6316 C.

Railroad Terminal Improvements at Providence, R. I. George B. Francis. Gives the history and illustrated description of the union terminal station developments which have been in progress for the last ten years. 17500 w. Jour Assn of Engng Socs—May, 1909. No. 6350 C.

Electrical Features of the New Northwestern Railroad Terminal in Chicago. Illustrated general account of the power plant, etc. 3500 w. Elec Wld—July 8, 1909. No. 6219.

Glasgow Central Station Extension. Donald Alexander Matheson. Describes the leading features of the extension scheme. Also discussion. Ills. 66000 w. Inst of Civ Engrs, No. 3737—Nov. 10, 1908. No. 6447 N.

See also Tunnels, under PERMANENT WAY AND BUILDINGS.

Track Construction.

Tracklaying Apparatus. J. F. Springer. Illustrates and describes the Harris Tracklaying Machine and its operation. 2000 w. Ry & Loc Engng—July, 1909. No. 6119 C.

Transfer Tables.

A Railway Transfer Table Without a Pit. Henry V. Miller. Illustrated description of a table recently built for the Southern Pacific Co., at Sacramento, Cal. 1200 w. Eng News—July 15, 1909. No. 6383.

Tunnels.

The East Side Tunnel and Its Approaches, Providence, R. I. Edwin P. Dawley. An illustrated description of this work in connection with the improved terminal facilities. 9500 w. Jour Assn of Engng Socs—May, 1909. No. 6351 C.

Yards.

Electric Installations in the Wustermark Distributing Yard (Die elektrischen Anlagen des Verschiebebahnhofes Wustermark). Herr Meyer. Describes the power plant, the uses to which the power is put, the lighting, etc. Ills. 3500 w. Elek Kraft u Bahnen—June 14, 1909. No. 6712 D.

See also Car Haulage, under MOTIVE POWER AND EQUIPMENT.

TRAFFIC.

Car Distribution.

Mine Inspection with Respect to Car Allotment. H. B. Douglas. Read before the Coal Min. Inst. of America. Discusses the proper method of mine rating, and matters relating to car distribution. 2500 w. Eng & Min Jour—July 3, 1909. No. 6170.

Combinations.

Railway Combinations from the Trader's Point of View. Alfred Mond. From report of the Board of Trade Railway Conference. The effects of combination are considered. 2500 w. Ir & Coal Trds Rev—June 18, 1909. No. 6055 A.

Freight.

Freight Handling on the Metropolitan Division of the Toronto and York Radial Railway. Describes the physical characteristics of this line, the equipment and methods. Ills. 2500 w. Elec Ry Jour—July 3, 1909. No. 6098.

I. C. C. Decisions.

The Dockets of the Interstate Commerce Commission. Logan G. McPherson. Gives a summary of complaints presented for the 15 months beginning Jan. 1, 1908, and ending March 31, 1909. 2800 w. R R Age Gaz—July 23, 1909. No. 6630.

MISCELLANY.

Apprenticeship.

Student Employees on the Harriman Lines. Interesting description of the method of training young men for positions in the operating departments. Gives abstract of curriculum. 3500 w. R R Age Gaz—June 4, 1909. No. 5287.

C. C. & O. R. R.

The Costliest Railroad in America. J. O. Lewis. Illustrations and brief description of the Carolina, Clinchfield & Ohio Railroad that cost more than thirty million dollars. 2000 w. Sci Am Sup—July 31, 1909. No. 6766.

China.

Railway Development in China. Arthur John Barry. Briefly outlines the history of the railway movement in China, showing the obstacles that had to be overcome, describing the railways constructed and giving interesting information. General discussion. 15000 w. Jour Soc of Arts—May 21, 1909. No. 5203 A.

Railway Development in China. R. C.

We supply copies of these articles. See page 1048.

Hardman. Outlines present means of transportation, what has been done toward the development of a railway system, and the outlook for expansion in the future. Ills. 3300 w. Transit—June, 1909, No. 6480 N.

Education.

Practical Education for Railroad Service. L. H. Turner. Gives the author's views in regard to the aim of practical education. Followed by general discussion. 14500 w. Pro Ry Club of Pittsburgh—May 28, 1909. No. 6357 C.

Indo-China.

The Railways of Indo-China (Note sur les Chemins de Fer de l'Indo-Chine). R. Godfernaux. Describes the lines, rolling stock, buildings, economic conditions, etc. Ills. Serial, 1st part. 9500 w. Rev Gen des Chemins de Fer—June, 1909. No. 6532 G.

Ireland.

The Bray and Wicklow Railway. Illustrated description of this railway on the Irish coast, where the encroachments of the sea causes great expense. 1500 w. Engr, Lond—July 9, 1909. No. 6429 A.

Management.

The Successful Mechanical Department Official. Fundamental principles underlying an efficient organization. Discusssion and comment. 2700 w. Am Engr & R R Jour—June, 1909. No. 5328 C.

Suggested Possibilities of Supply Department Management. George G. Yeomans. Gives a comparison of the amount of material and supplies in stock on different railways and analysis of conditions that should determine the amount of stock to be carried. 3500 w. R R Age Gaz—July 30, 1909. No. 6781.

Mexico.

Railway Policy and Operation in Mexico. An explanation of the government policy and the changes in methods of operation. 1600. R R Age Gaz—July 2, 1909. No. 6125.

What the Southern Pacific Will Do for Mexico. Eugene A. H. Tays. Gives information in regard to the railway facilities, explaining the nature of the Mexican people, and giving reasons for prophesying great benefits to the country and company. 2000 w. Min Wld—July 3, 1909. No. 6140.

Norway.

The Christiania-Bergen Railway. Ole W. Lund. History and illustrated description of a line constructed through difficult country; remarkable for the height to which it rises, the severe climate and enormous masses of snow, and the number of tunnels. 3300 w. R R Age Gaz—July 30, 1909. No. 6782.

Statistical Charts.

The Logarithmic Scale in Graphic Charts. W. J. Cunningham. An explanation of the use of such charts in railway statistics. 1500 w. R R Age Gaz—June 25, 1909. No. 5885.

STREET AND ELECTRIC RAILWAYS.

Accounting.

Electric Railway Accounting. A. L. Linn, Jr. Abstract of paper before the St. Ry. Assn. of the State of N. Y. A study based on usage of the uniform system prescribed by the Public Service Commission of the Second District. Also discussion. 5000 w. Elec Ry Jour—July 3, 1909. No. 6100.

Bombay.

The Tramways of Bombay. Illustrated detailed description of the system as converted to electric traction. 3000 w. Tram & Ry Wld—July 8, 1909. No. 6605 B.

Canal Traction.

Electric Haulage on Canals. Extract translated from an article by Dr. G. Meyer, referring to recent developments. 1200 w. Elec Rev, Lond—July 9, 1909. No. 6419 A.

Electric Haulage of Canal Boats (Halage électrique des Bateaux). Léon Gerard. A discussion of M. du Bousquet's paper, referring principally to the results of the Lehigh Canal tests. Ills. 4400 w. Mem Soc Ing Civ de France—May, 1909. No. 6503 G.

Conduit System.

Improvements in Conduit Railway Construction in London. Describes features of interest in the construction and management. 2500 w. Elec Ry Jour—July 3, 1909. No. 6099.

Direct Current.

Electric Traction by Constant-Intensity Continuous Current (Discussion de la Communication de M. J. Bourdel). M. Bourdel's reply to discussion. 5300 w. Bul Soc Int d Elecns—June, 1909. No. 6506 F.

Electric Traction.

Electric Traction on Railways (La Traction électrique sur les Chemins de Fer). H. Marchand. Makes a general comparison between steam and electricity, in this number. Ills. Serial, 1st part. 14000 w. Soc Belge d'Elecns—June, 1909. No. 6501 E.

England.

English Electric Railways. Outlines what has been accomplished in England up to the present time. 2500 w. R R Age Gaz—July 9, 1909. No. 6237.

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Fish Plates.

An Electro-Mechanical Fish Plate (Une Eclisse electro-mécanique). E. Sauvage. Describes an invention so-called because it may be used on electric railways without any further bond. Ills. 4000 w. Bul Soc d'Encour—May, 1909. No. 6523 G.

Interurban.

Waterbury Extensions of the Connecticut Company. Illustrates and describes recent extensions to North Woodbury and to Thomaston, Conn. 1500 w. Elec Ry Jour—July 31, 1909. No. 6775.

Locomotives.

The Construction of Alternating-Current Locomotives (Neuere Bauarten von Wechselstrom-Lokomotiven). G. Brecht. Discusses a number of recent designs. Ills. 2300 w. Zeitschr d Ver Deutscher Ing—June 19, 1909. No. 6729 D.

The Driving of Electric Trunk-Line Locomotives (Beitrag zur Frage des Antriebes elektrischer Vollbahnlokomotiven). Herr Heyden. Discusses the various systems of power transmission from motor to axle. Ills. 2800 w. Elek Kraft u Bahnen—June 4, 1909. No. 6711 D.

See also Simplon, under STREET AND ELECTRIC RAILWAYS.

Power Transmission.

See Electrification, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

Railless.

Railless Traction Systems. An illustrated report by a Leeds committee of investigation, especially considering the Mercedes-Stoll, and the Filovia systems. 2200 w. Tram & Ry Wld—July 8, 1909. No. 6607 B.

Simplon.

The Operation of the Simplon Tunnel Railway. Illustrated description of the old and new locomotives and the power supply. 1400 w. Eng News—July 29, 1909. No. 6767.

Speed Recorders.

A Calibrated Speed Recorder. A. B. Stitzer. Illustrates and describes a speed recorder adapted for electric traction work, making a record that can be read without a correcting factor. 1500 w. Pro Engrs' Club of Phila—Jan., 1909. No. 6358 D.

Subways.

The New Tunnel System Under the Hudson River. Plan and brief description of this tunnel system, nearing completion. 1600 w. Eng Rec—July 24, 1909. No. 6651.

Opening of the Terminal Station of the Hudson and Manhattan Railroad. Illustrates and describes details of stations, track construction and service. 5000 w. Elec Ry Jour—July 17, 1909. No. 6367.

Progress on the Subway Bridge Loop, New York. Illustrates and describes recent work on this loop which will connect the Brooklyn and Williamsburg bridges in Manhattan. 2500 w. Eng Rec—June 26, 1909. No. 6001.

A Project for Underground Electric Railways in Vienna (Projekt, betreffend elektrische Untergrundbahnen durch die Innere Stadt Wien). Karl Hochenegg. A brief outline of the proposed lines. Ills. Serial, 1st part. 2000 w. Zeitschr d Oest Ing u Arch Ver—June 25, 1909. No. 6597 D.

Terminals.

New Terminal of the Public Service Railway at Hoboken, N. J. Martin Schreiber. Illustrated description of a new terminal under construction, adjacent to the D. L. & W. station, and the station of the Hudson and Manhattan R. R. tunnels. 2500 w. Elec Ry Jour—Aug. 7, 1909. No. 6915.

Test Cars.

Special Testing and Repair Cars. Illustrated descriptions of two examples of special cars in service in Vienna and in Marseilles. 1500 w. Tram & Ry Wld—June 3, 1909. No. 5595 B.

Track Construction.

The Influence of Mining on Street Railway Lines and Its Prevention (Der Einfluss des Bergbaues auf Strassenbahngleise und seine Bekämpfung). Herr Korten. Discusses earth settlement in the Rhine-Westfalian coal district and railway track construction to overcome its effects. Ills. 5200 w. Glückauf—June 19, 1909. No. 6575 D.

Track Maintenance.

Boston Elevated Railway Co. Track Maintenance. Describes methods used on surface lines. Ills. 1800 w. Elec Ry Jour—June 5, 1909. No. 5259.

Trolley Lines.

Some Details of Overhead Construction. E. Goolding. Describes points of interest in recently executed work. Ills. 1500 w. Tram & Ry Wld—June 3, 1909. No. 5596 B.

Trunk Lines.

The Electrical Operation of Trunk Lines from a Military Point of View (Die Aussichten des elektrischen Vollbahnbetriebes mit besonderer Berücksichtigung der militärischen Bedenken). R. Rinkel. With special reference to conditions in Germany. Ills. 2800 w. Elek Kraft u Bahnen—May 24, 1909. No. 5953 D.

Electric Trunk Line Construction in the United States (Bau elektrischer Hauptbahnen in den Vereinigten Staaten). E. C. Zehme. A discussion of the various important lines. Ills. Serial, 1st part. 3500 w. Glaser's Ann—June 1, 1909. No. 6588 D.

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EXPLANATORY NOTE—THE ENGINEERING INDEX

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THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Anales de la Soc. Cien. Argentina. *m.* Buenos Aires.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. Ing. d Arch Ital. *s-m.* Rome.
Applied Science. *m.* Toronto, Ont.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *w.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brass World. *m.* Bridgeport, Conn.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bull. Bur. of Standards. *qr.* Washington.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin du Lab. d'Essais. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. of Can. Min. Inst. *qr.* Montreal.
Bull. Soc. Int. d'Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Bull. Scien. de l'Assn. des Elèves des Ecoles Spéc. *m.* Liége.
Bull. Tech. de la Suisse Romande. *s-m.* Lausanne.
California Jour. of Tech. *m.* Berkeley, Cal.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *w.* Toronto and Montreal.
Canadian Mining Journal. *b-w.* Toronto.
Cassier's Magazine. *m.* New York and London.
Cement. *m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Clay Record. *s-m.* Chicago.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.

Comptes Rendus de l' Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Cornell Civil Engineer. *m.* Ithaca.
Deutsche Bauzeitung. *b-w.* Berlin.
Die Turbine. *s-m.* Berlin.
Domestic Engineering. *w.* Chicago.
Economic Geology. *m.* New Haven, Conn.
Electrical Age. *m.* New York.
Electrical Engineer. *m.* London.
Electrical Engineering. *w.* London.
Electrical Review. *w.* London.
Electrical Review. *w.* New York.
Electric Journal. *m.* Pittsburg, Pa.
Electric Railway Journal. *w.* New York.
Electrical World. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Elektrische Kraftbetriebe u Bahnen. *w.* Munich.
Electrochemical and Met. Industry. *m.* N. Y.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnik u Maschinenbau. *w.* Vienna.
Elektrotechnische Rundschau. *w.* Potsdam.
Elettricità. *w.* Milan.
Engineer. *w.* London.
Engineering. *w.* London.
Engineering-Contracting. *w.* New York.
Engineering Magazine. *m.* New York and London.
Engineering and Mining Journal. *w.* New York.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U. S. A.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giesserei-Zeitung. *s-m.* Berlin.
Glaser's Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating Mag. *m.* New York.
Ice and Cold Storage. *m.* London.
Ice and Refrigeration. *m.* New York.
Il Cemento. *s-m.* Milan.
Industrial Engineering. *m.* Pittsburg.
Industrial World. *w.* Pittsburg.
Ingegneria Ferroviaria. *s-m.* Rome.
Ingenieria. *b-m.* Buenos Ayres.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Int. Marine Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. of Accountancy. *m.* N. Y.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal Franklin Institute. *m.* Philadelphia.
Jour. Ind. & Engng. Chem. *m.* Easton, Pa.
Journal Royal Inst. of Brit. Arch. *s-q.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. of Engineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Jour. Transvaal Inst. of Mech. Engrs., Johannesburg, S. A.
Jour. of U. S. Artillery. *b-m.* Fort Monroe, U. S. A
Jour. W. of Scot. Iron & Steel Inst. *m.* Glasgow.
Journal Western Soc. of Eng. *b-m.* Chicago.
Jour. of Worcester Poly. Inst., Worcester, U. S. A.
Locomotive. *m.* Hartford, U. S. A.
Machinery. *m.* New York.
Manufacturer's Record. *w.* Baltimore.
Marine Review. *m.* Cleveland, U. S. A.
Mechanical Engineer. *w.* London.
Mechanical World. *w.* Manchester.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Métallurgie. *w.* Paris.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining World. *w.* Chicago.
Mittheilungen des Vereins für die Förderung des Local- und Strassenbahnwesens. *m.* Vienna.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *w.* New York.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Oest. Wochensch. f. d. Oeff. Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg & Hüttenwesen. *w.* Vienna.
Plumber and Decorator. *m.* London.
Power and The Engineer. *w.* New York.
Practical Engineer. *w.* London.
Pro. Am. Ins. Electrical Eng. *m.* New York.
Pro. Am. Ins. of Mining Eng. *m.* New York.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Am. Soc. Mech. Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. Engrs. Soc. of Western Pennsylvania. *m.* Pittsburg.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Pro. U. S. Naval Inst. *qr.* Annapolis, Md.
Public Works. *qr.* London.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railroad Age Gazette. *m.* New York.
Railway and Engineering Review. *w.* Chicago.
Railway and Loc. Engng. *m.* New York.
Railway Master Mechanic. *m.* Chicago.
Revista Tech. Ind. *m.* Barcelona.
Revue d'Electrochimie et d'Electrométallurgie. *m.* Paris.
Revue de Mécanique. *m.* Paris.
Revue de Métallurgie. *m.* Paris.
Revue Gén. des Chemins de Fer. *m.* Paris.
Revue Gén. des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Rivista Marittima. *m.* Rome.
Schiffbau. *s-m.* Berlin.
School of Mines Quarterly. *q.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Eng. *m.* Ithaca, N. Y.
Signal Engineer. *m.* Chicago.
Soc. Belge des Elect'ns. *m.* Brussels.
Stahl und Eisen. *w.* Düsseldorf.
Stevens Institute Indicator. *qr.* Hoboken, U. S. A.
Surveyor. *w.* London.
Technik und Wirtschaft. *m.* Berlin.
Technique Moderne. *m.* Paris.
Tramway & Railway World. *m.* London.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Wood Craft. *m.* Cleveland, U. S. A.
Yacht. *w.* Paris.
Zeitschr. f. d. Gesamte Turbinenwesen. *w.* Munich.
Zeitschr. d. Mitteleurop. Motorwagen. Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschr. f. Werkzeugmaschinen. *b-w.* Berlin.

CURRENT RECORD OF NEW BOOKS

NOTE—Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post Office Orders, home and foreign, should be made payable to THE ENGINEERING MAGAZINE.

Applied Mechanics.

Applied Mechanics for Engineers. By E. L. Hancock. Size, 7½ by 5 in.; pp., 385. Ills. Price, $2. New York: The Macmillan Company.

An elementary text-book of mechanics for engineering students, especially designed to show the application of theory to practical problems. The subject-matter is such as is usually covered by the work of one semester. The treatment and arrangement of material are much the same as in older works on the same subject, but special completeness is claimed for the chapters on moments of inertia, center of gravity, work and energy, friction, and impact. The special value of the book lies in the problems, which are numerous and, in general, well chosen for their purpose of illustrating mechanical principles by reference to practical engineering work.

Bridge Design.

The Design of Highway Bridges and the Calculation of Stresses in Bridge Trusses. By Milo S. Ketchum. Size, 9 by 6 in.; pp., xiv, 394. Ills., 300. Plates, 8. Price, $4. New York: The Engineering News Publishing Co.; London: Archibald Constable & Co.

A supplementary work to the author's well-known "Design of Steel Mill Buildings." Its aim is to give a brief course in the calculation of the stresses in bridge trusses, followed by a systematic discussion of the details and design of highway bridges. The book is divided into three parts. In the first, the calculation of stresses in steel bridges is discussed in detail under the headings Types of Steel Bridges, Loads and Weights of Highway Bridges, Methods for the Calculation of Stresses in Framed Structures, Stresses in Beams, Stresses in Highway Bridge Trusses, Stresses in Railway Bridge Trusses, Stresses in Lateral Systems, Stresses in Pins, Eccentric and Combined Stresses, Deflection of Trusses, Stresses in Rollers, and Camber, and the Solution of Problems in the Calculation of Stresses in Bridge Trusses. The second part deals more specifically with the design of highway bridges of all types, steel, masonry, and timber, the design of abutments and piers, and the erection and estimation of weight and cost of highway bridges. In Part III a complete design for a steel highway bridge is worked out in detail. An appendix gives general specifications for steel highway bridges. The book will be found thoroughly satisfactory for use in the class room and in engineering practice.

Cost Systems.

Nicholson on Factory Organization and Costs. By J. Lee Nicholson. Size, 11¼ by 8 in.; pp., 410. Ills. Price, $12.50. New York: Kohl Technical Publishing Co.

The treatment shows three divisions: a general discussion of the theory and elements of costs, occupying 57 pages; a presentation of cost forms and systems, filling about 290 pages; and an illustrated list of mechanical office appliances, covering 60 pages. The publishers adopt the unfortunate course of introducing the book as the only standard work on factory organization and costs ever published, and as being sufficient to make the manufacturer his own system specialist and thus to save him the fee of a professional adviser.

The claim compels a searching examination which the book proves unable to stand. Of the preliminary portion, the chapter on distribution of indirect expenses is excellent and properly used should be well worth the whole cost of the book. That on wage systems is wholly insufficient in range, while its standard of accuracy may be judged by the following extract: "The principle (in the bonus system) is the same as in the premium plan and whatever remarks apply to one plan apply also to the other." There is practically nothing on the subject of materials, and the chapter on organization and cost finding is disappointing, in that

it gives no instruction on the fundamental propositions of cost accounting—what facts to get, how to get them, and what to do with them after you have them. With so meagre a preparation only, the user of the book would not be competent to decide upon the selection or use of the forms shown—to discriminate, for example, between the seven different designs for report of material received, the nine different forms of stock record, the sixteen kinds of production orders, or the twenty-eight forms of time tickets, etc. The value of the book is to the cost accountant advanced enough to appreciate the principles and ideas embodied in these forms, and to select from them or adapt them to his purposes.

Industrial Betterment.

Social Engineering. By William H. Tolman, Ph.D. Size, 9¼ by 6 in.; pp., 384. Ills. Price, $2.50. New York: McGraw Publishing Co.

A large and varied collection of instances of industrial betterment or welfare institutions, gathered from many manufacturers and corporations. The material is assembled under the chapter headings Efficiency Promotion, The Social Secretary, Hygiene, Safety and Security, Mutuality, Thrift, Profit-Sharing, Housing, Education, Recreation, Communal or Social Betterment, and Does It Pay?

There is a lack of careful discrimination, and apparently of first-hand knowledge, either of leading cases in practice or of the literature of the subject. The development of material in disregard of the fundamental data of industrial engineering leads to some fantastic results. For example, the premium plan is confused with profit-sharing, while the bonus and efficiency systems, as developed by Taylor, Gantt, Emerson and others, are totally ignored. Under profit-sharing the Roycrofters are given a half-page, besides four other references, while Procter & Gamble are never mentioned. Westinghouse apprentice instruction is described at length; the institutions of the General Electric Co. and the New York Central and Santa Fe Railways for the same purpose are examples of the class of important instances apparently unknown to the author. The Jordan-Marsh promotion of instruction in salesmanship is treated as a remarkable idea while the highly developed methods of the Herring-Hall-Marvin Safe Co. or the National Cash Register Co. for the same purpose are not referred to. Much space is given to hospital service promoted by employers, the Southern Pacific system being introduced twice, but the splendid medical department of the Santa Fe is not so much as hinted at. In general, the presentation seems to be limited to the employers' point of view, and to be overweighted with attention to the social idea, but unconscious of that larger policy of encouraging individual efficiency, individual effort, and individual reward, which the wisest managers are recognizing as better suited to the improvement of American industrial conditions.

Lead and Zinc.

Lead and Zinc in the United States. By Walter Renton Ingalls. Size, 9½ by 6½ in.; pp., 368. Ills. Price, $4. New York and London: Hill Publishing Company.

An economic history of the mining and smelting of lead and zinc and of the conditions which have affected the development of the industries, prepared at the request and with the assistance of the Carnegie Institution to form a part of the Economic History of the United States. Introductory chapters in the section devoted to lead include a general discussion of the occurrences of lead ore, a chronology of lead mining and smelting, a description of past and present metallurgical practice, and a review of methods of refining and marketing and of the uses of the metal. The lead-mining industry in the various states is then discussed in detail. The section concludes with chapters on statistics of production, consumption and price, commercial conditions, the tariff on lead, labor conditions, and trade agreements and combinations. The zinc-mining industry is treated more briefly but in much the same way; chapters are devoted to the occurrence of zinc ore in the United States, zinc mining, ore dressing, zinc smelting, and commercial conditions. Besides being a history of the lead and zinc industries, the book is an up-to-date treatise on present practice and can be recommended as an authoritative treatment of the subject.

Piping Systems.

Steam Power Plant Piping Systems. By William L. Morris. Size, 9½ by 6½ in.; pp., xv, 490. Ills. Price, $5. New York: McGraw-Hill Book Company.

A valuable contribution to the literature of a branch of engineering in which the need of an authoritative and exhaustive discussion such as this has long been urgently felt. The author's aim has not been to compile a reference book but to give a detailed and consecutive treatment of the entire subject of piping systems as applied to power stations, their design, installation and maintenance. Complete systems are discussed first and then each detail in turn. The design of boilers and engines has not been touched upon,

though their operation has been covered, but all auxiliary apparatus in the pipe circuit between the boiler and the engine and in the various piping systems for steam, oil, air, etc., have been treated and their general design discussed. Besides the pipe circuit between the boilers and engines, all other piping systems are considered. Special chapters are devoted, for example, to city and artesian water piping details, fire service piping, water treatment apparatus, hydraulic elevators, grease sewers, etc. A further feature of interest is a suggestion for a better method of contracting this line of work, which will entail less expense both to the designer and to the contractor, and at the same time insure a higher grade of work.

Railroad Shop Organization.

Betterment Briefs. A Collection of Published Papers on Organized Industrial Efficiency. By H. W. Jacobs, Assistant Superintendent M. P., A. T. & S. F. Railway. Size, 9½ by 6 in.; pp., 271. Ills., 152. Price, $3.50, 15/. New York: John Wiley & Sons. London: Chapman & Hall, Ltd.

Many of these papers appeared originally in The Engineering Magazine, and the collection when first privately issued under the present title in February, 1908, was reviewed in these columns. The persistent demand for the volume has led to this issue in commercial form by Messrs. John Wiley & Sons. In this new edition two additional chapters are included, one on the general tool system of the A. T. & S. F. Railway and the other on locomotive repair costs. The book is full of valuable material, exactly descriptive of the methods that have attracted the attention of American railroad men everywhere by the economies shown in the operating costs of the Santa Fe. It should find a wide market among the officials of mechanical railway departments on this account alone. We hope, however, that when the demand necessitates a new edition Mr. Jacobs or his editors will depart much more than they have yet done from the original form of these papers and from the chronological arrangement, and will reduce the best of this material to a more systematic form, still further enriched with the additional subject matter which the present condition of the Santa Fe mechanical department would abundantly supply.

Sewer Construction.

Sewer Construction. By Henry N. Ogden. Size, 9 by 6 in.; pp., xii, 335. Ills., 192. Price, $3, 12/6. New York: John Wiley & Sons; London; Chapman & Hall.

A companion volume to the author's "Sewer Design," already published. The material, which was originally compiled for a course of lectures given in the College of Civil Engineering, Cornell University, has been drawn principally from the current literature of the subject contained in books, technical periodicals, and the reports of engineers and city officials on sewerage systems. Six chapters are devoted to materials of construction, terra-cotta pipe, brick, concrete, concrete and brick, and reinforced concrete. Manholes, catch-basins, siphons, screens, storm-water overflows and regulators, and bell mouths are treated in separate chapters. Sewer foundations are next discussed, and a number of examples of outfall sewers are described in considerable detail. Short chapters are given to house connections, surveying and trenching. Valuable data are presented in a section on estimates and costs, and the book concludes with a long and interesting chapter on specifications and contracts. On the whole, Mr. Ogden has produced a survey of modern sewer practice of considerable value to the student and to the engineer who takes up the problem of sewer construction for the first time.

BOOKS RECEIVED.

Hydraulic Engineering. By Gardner D. Hiscox. Size, 9 by 6 in.; pp., 315. Ills. Price, $4. New York: The Norman W. Henley Publishing Company.

Electrical Illuminating Engineering. By William Edward Barrows. Size, 8½ by 5½ in.; pp., 216. Ills. Price, $2. New York: McGraw Publishing Company.

Electric Railway Auditing and Accounting. By Wm. H. Forse, Jr. Size, 8½ by 5½ in.; pp., 157. Ills. Price, $2. New York: McGraw Publishing Company.

A Manual of Underground Surveying. By Loyal Wingate Trumbull. Size, 9½ by 6½ in.; pp., 251. Ills. Price, $3. New York and London: Hill Publishing Company.

Highway Engineering. By Chas. E. Morrison. Size, 9 by 6 in.; pp., 315. Ills., 60. Price, $2.50, 10/6. New York: John Wiley & Sons. London: Chapman & Hall, Ltd.

Steam Power Plant Engineering. By G. F. Gebhardt. Size, 9 by 6 in.; pp., xxix, 816. Ills., 461. Price, $6, 25/6. New York: John Wiley & Sons. London: Chapman & Hall, Ltd.

Elements of Railroad Track and Construction. Winter L. Wilson. Size, 7½ by 5 in.; pp., 320. Ills, 181. Price, $2, 8/6. New York: John Wiley & Sons. London: Chapman & Hall, Ltd.

A Text-Book on Roads and Pavements. By Frederick P. Spalding. Third Edition. Size, 7½ by 5 in.; pp., x, 340, Ills., 51, Price, $2, 8/6. New York: John Wiley & Sons. London: Chapman & Hall, Ltd.

THE CURRENT RECORD OF
IMPROVED MACHINERY
NEW METHODS NEW MATERIALS
NEW APPLIANCES

Duff-Bethlehem Forged Steel Hydraulic Jacks.

THE Duff Manufacturing Company, of Pittsburg, Pa., manufacturers of the Barrett jacks and Duff ball bearing screw jacks, has put on the market the Duff-Bethlehem forged steel hydraulic jacks, completing their already large line of jacks of all types. The Duff-Bethlehem hydraulic jacks are forged entirely of steel, and patents covering its special features and construction have been allowed the Bethlehem Steel Company, who have designed and perfected this jack and who do the special forging necessary. The Duff Manufacturing Company have the exclusive handling of this Duff-Bethlehem jack in connection with their line of Barrett and Duff jacks. These new types of jacks have special features whereby the imperfections and troublesome conditions in the usual hydraulic jack construction are entirely avoided. The Duff-Bethlehem jacks weigh from 30 per cent. to 60 per cent. less than hydraulic jacks of any other style, of equal lifting capacity and stroke, a reduction made possible by its forged steel construction. It further provides greater strength, capacity and durability. Both the cylinder and ram of the Duff-Bethlehem jacks have a solid bottom, thus requiring no packings, and dispensing with joints at those points. The most troublesome packing in other designs of hydrulic jacks is at the bottom of the cylinder. As the cylinder of the Duff-Bethlehem jacks has its base or bottom forged integrally therewith, it obviates entirely this troublesome feature of packing.

Another packing, that insuring closure of the ram piston from the pump socket, is also entirely dispensed with, as the Duff-Bethlehem Jack has a solid bottom forged integrally with the pump socket. There are practically only two small packings in the entire jack, and as joints are also eliminated, there is no chance for leakage and no expense whatever for renewal of packings.

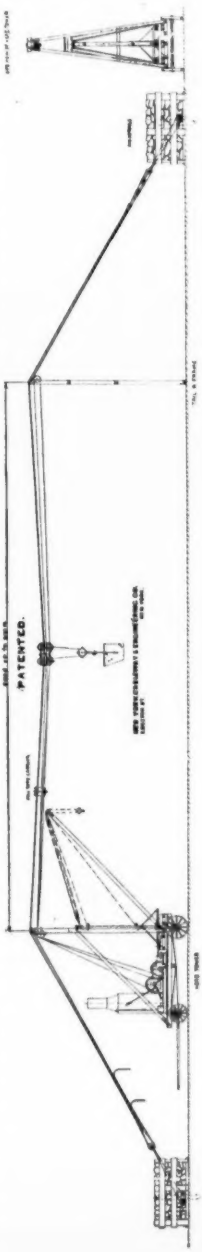
By the improved construction and location of valves the Duff-Bethlehem jacks are capable of extending their full length in a vertical, horizontal or inclined position, without any adjustment whatever, and all sizes will operate at any angle. In the operating mechanism a minimum number of parts of

simple and strong construction is employed, and any parts may be easily replaced if necessary, without special tools. Also, in this construction, the valves may be attended to without removing the packing, and the packing without removing the valves. The valves are absolutely positive and require no special adjustments or parts to insure their operating under all conditions. The load may be tripped or may be lowered as slowly as desired, or stopped at any point when lowered if desired.

These jacks are constructed of open hearth fluid compressed forged steel and bronze and their inside working parts are drop forgings. They are made in all types and capacities adapted to railway and general lifting purposes. The Duff-Bethlehem "low" or telescope type represents the highest development yet attained in hydraulic jack construction, and is designed as the highest grade tool in the hydraulic jack field, forged entirely of steel, fitted with an improved duplex pump, automatically regulating the change of speed proportional to the load being lifted and made regularly with capacities ranging from 30 tons to 300 tons, and higher capacities if required. This line of hydraulic jacks is complete, and together with the Duff Manufacturing Company's line of Barret jacks. Duff ball bearing screw jacks, etc., covers practically every type of lifting jack for every possible condition and lifting purpose.

Combined Cableway and Derrick.

THE New York Cableway & Engineering Co., 3 Rector street, New York City, is placing on the market a combined traveling derrick and cableway head tower which differs from the ordinary head tower for a sewer cable-way in having a stiff-leg derrick and an additional set of drums mounted on the same shafts with the regular drums. The derrick is placed on the forward end of the platform directly under the cableway. Both the derrick and the engine will be built to suit the conditions, but the standard machine designed by the company has either a 26 or 30-ft. boom, and the engine has double cylinders, 8¼ x 10 in., designed for a 5,000-lb. load. Two drums are placed on each of two shafts, designs having been prepared for two different arrangements. In one arrangement the gears and the friction are at the end of the smaller drums, which, with the



larger one, is permanently keyed to the shaft. With this arrangement it is necessary to detach one set of ropes when either the cableway or derrick is put out of commission.

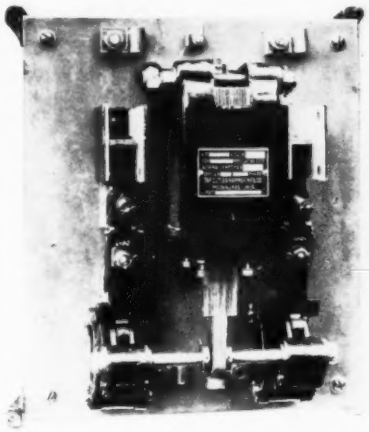
In the other type of engine the gears are placed between the two drums on each shaft and a friction provided for each of the four drums, so that all of the lines can be left permanently attached, and either the derrick or cableway worked at will. The company believes that the derrick will prove of considerable value in conjunction with the operation of the cableway itself for erecting the tail tower, and swinging buckets, pipe, sheeting and other materials from under the cableway to wagons standing beside the trench.

The boom is slewed by a swinging device, placed between the derrick and the hoisting engine. The A-frame is so attached to the bed of the head tower that it can be readily removed, and the entire equipment can be mounted in any manner desired, on skids, small or large wheels. The combination head tower can be purchased separately, if desired, and the remainder of the cableway equipment added at a later date.

A. C. Self-Starters.

A NEW line of self-starters designed for use with alternating current motors has recently been placed on the market by the Cutler-Hammer Mfg. Co. of Milwaukee. These include self-starters for use with single, two- or three-phase motors which may be thrown directly across the line to start, two types of self-starters for squirrel cage motors, and two for slip ring motors. In addition to these five types of self-starters the same company has brought out a line of two-pole and three-pole float switches. The float switch is used in connection with a copper float, chain and weight for automatically starting and stopping motors operating pumps on open tank systems. By adjusting the two buttons on the chain passing through an eye in the arm of the float switch, this arm will be moved up or down whenever the water in the tank reaches a predetermined high or low level, thus opening or closing the circuit to the solenoid of the self-starter which in turn operates to stop or start the motor.

These self-starters are designed for those installations where the motor is comparatively small, and may be thrown directly across the line to start without the intervention of starting resistance. They may be used with single, two or three phase motors of suitable type. For single-phase systems, both sides of the line to the motor are controlled. For two-phase systems, the circuit to the motor is controlled by a single pole switch in each phase circuit. For three-phase systems, the circuit from two of the three-phase wires to the motor is



controlled, the other phase wire being connected to the motor directly.

The self-starter consists of a double pole solenoid operated switch, which may be controlled by either a pressure regulator or float switch, depending upon the system used. With a compression tank system, the pressure regulator is to be used, and the motor will be stopped and started automatically at the two limits of pressure for which the regulator is adjusted. With an open tank system, the float switch is to be used, and the motor will be stopped and started at the two limits of water level in the tank for which the float switch is adjusted.

When the self-starter is to be used on a single-phase circuit, it is essential that

the motor it controls be self-starting and will develop the necessary starting torque. Standard two-phase or three-phase squirrel cage type induction motors are in general suitable for operation under these conditions.

The solenoid switch is a double pole switch of open construction operated by a single-phase solenoid magnet. The current carrying contacts are laminated copper brushes pressed against stationary copper contacts by a toggle joint mechanism, insuring a perfect contact. The circuit is always opened and closed at the arcing contacts, which are of carbon and copper and are readily renewable. The switch parts are mounted on a slate panel, and suitable terminals for external connections are provided. Where the self-starter is used on a closed tank system, a relay is provided to control the solenoid circuit from the pressure regulator; but where it is used on an open tank system, the solenoid circuit is controlled directly by the float switch.

NEWS SUPPLEMENT

The Engineering Magazine—April, 1909

Personal.

—David E. Harding, treasurer of the S. W. Card Manufacturing Co., Mansfield, Mass., died on February 2.

—Ervin Saunders, vice-president of D. Saunders' Sons, Inc., of Yonkers, N. Y., died at Yonkers on February 17 last, aged sixty-one years.

—Henry Bausch, second vice-president of the Bausch & Lomb Optical Co., died at Atlanta, Ga., on March 2, where he had gone in the hope of restoring his health. Mr. Bausch was the third son of J. J. Bausch, and gave most of his attention in the Bausch & Lomb business to the scientific problems connected with the construction of lenses and other optical parts of scientific instruments, particularly miscroscopes, a work in which he was thoroughly trained.

—Edwin Reynolds, for thirty years practical head of the Edward P. Allis Company, now the Allis-Chalmers Company, died February 19, aged seventy-eight years. Having received the usual education afforded by the public schools, he became an apprentice to a small machinist in Mansfield, Conn. With his trade fairly learned he sought and secured work in machine shops in Connecticut, Massachusetts and Ohio. Later he went to Aurora, Ind., as superintendent of the machine shops of Steadman & Co., engaged in the building of engines, saw mills and drainage pumps for Mississippi plantations. At the outbreak of the war between the states, Mr. Reynolds returned to Connecticut, and for six years he was active in his trade in the States and in Boston and New York, during which time he worked upon the machinery of Erickson's "Monitor." He then went to Providence, R. I., entering the shops of the Corliss Steam Engine Company. In 1871 he was made general superintendent of the plant, remaining until 1877, when, at the earnest solicitation of the late Edward P. Allis, he resigned to engage with Edward P. Allis & Co. at Milwaukee.

Industrial Notes.

—The Hughson Steam Specialty Co. has succeeded to the business of the Davis Eclipse Regulator & Steam Specialties Co. at 860 So. Halstead street, Chicago, Ills. George H. Hughson, former vice-president and secretary of the John Davis Co., is president of the Hughson Steam Specialty Co.

—In order to take care of increased busi-

ness The L. J. Wing Mfg. Co. has increased its capital from $25,000 to $100,000, and has secured offices at its present address, 90 West Street, New York, twice the size of those at present occupied by them. While the ventilating business of the company has greatly increased, the principal increase is in the sales of the Wing "Typhoon" turbine blower made by that company.

—The Cutler-Hammer Mfg. Co., of Milwaukee, makers of electric controling devices, announce the opening of a district office in Cleveland, Ohio, at 1108 Schofield building. The new office will be in charge of C. J. Kruse, who comes from the engineering department of the Cutler-Hammer company and who is qualified to advise regarding the proper device to use in any case involving the control of electric motors.

—The Nelson Valve Co., Wyndmoor, Pa., has surrendered its New Jersey charter and taken out a new charter under the laws of Pennsylvania. This company was organized in 1893, and it is now proposed to enlarge the plant considerably and provide for the manufacture of a new type of Nelson valve designed particularly for superheated steam service. The composition of it will be nickel-steel. The new buildings are to be of reinforced concrete.

—In Bulletin No. 4649, just issued by the General Electric Company, the relative advantages and disadvantages of independent drive and group drive of machine tools are demonstrated. While the title of the bulletin refers to railroad shops, the data are applicable to machine shops in general. The bulletin refers also to the relative merits of alternating and direct current for use in this connection, and it contains numerous illustrations of machine tools operated by electric motors.

—The Turner Construction Co., of New York, has been awarded contracts recently as follows: For a reinforced concrete sulphur storage house at the Erie Basin, Brooklyn, for the Union Sulphur Company; reinforced concrete floors and columns for a three-story bakery for John Schmalz & Sons, Eighth and Clinton streets, Hoboken —size of buiilding 70 x 100 ft.; a reinforced concrete cold storage warehouse for the Union Terminal Cold Storage Company, Jersey City—size of building 72 x 100 ft., 6 stories, basement and attic. Work will be undertaken at once on all three of these contracts.

—Among the recent orders taken by the Crocker-Wheeler Company of Ampere, N. J., is one for a 250 K. W. motor-generator set for the Tennessee Coal, Iron & Railroad Co., at Ensley, Ala. It will consist of a 250 K. W., 275 volt, D. C. generator driven by a 6,600 volt, 3-phase, 25-cycle synchronous motor and will be used as an exciter. Another order is one for about 50 horsepower of small elevator motors purchased by the Haughton Elevator & Machine Co., of Toledo, Ohio. Yawman & Erbe, of Rochester, New York, have also placed orders for a number of 2/5 horsepower motors for use on some of their specialties.

—Hoskins Manufacturing Company, formerly the Hoskins Company, of Chicago, has opened its new plant and general offices at 453 to 471 Lawton avenue, Detroit, Mich. Here the company has an extensive factory, new equipment, and enlarged facilities for making and distributing its line of electric furnaces, pyrometers and heating appliances. With the reorganization and increase of capital to $500,000, the management remains the same as before: Hoyt Post, president; W. W. Talman, vice president and sales manager; E. F. Hoskins, general manager and treasurer; and Jonathan Palmer, Jr., secretary. A. L. Marsh will continue in the capacity of electrical engineer for the company.

—The Rockwell Furnace Company has been awarded the contract covering the complete furnace equipment for the new locomotive shops of the D., L. & W. R. R. at Scranton, Pa. The furnace equipment consists of thirty-five of the latest type furnaces operated with 300 B.T.U. water gas, which is made in Loomis-Pettibone producers. These shops will be capable of turning out complete locomotives, and are to be in operation in three months. No pains or expense has been spared to make them up to date, as they embody the latest and most improved machinery and equip-

ment selected after thoroughly inspecting a large number of modern railway and industrial plants throughout the country.

—"The Best Road and the Right Way to Make It" is the title of an artistic and most interesting pamphlet by Amzi Lorenzo Barber, of the A. L. Barber Asphalt Co., 90 West Street, New York. Mr. Barber has been so long a thorough student of road-making that his opinions and conclusions must bear the weight of authority. The present pamphlet deals more particularly with country roads, but is a pamphlet to be read, studied and kept by any one interested in road-making and up-keep. The development of modern road-making is interestingly unfolded, from the bituminous lime stone roads laid in Paris in 1854 to the present day, referring at length to the De Smedt patents and the roads paved with sand-asphalt in the early seventies. Mr. Barber's analyses and comparisons of materials are most interesting.

—During the fall of 1909 an industrial exhibition of American manufactures will be held at Santiago, Chile, under the auspices of the South American Exhibit Co. with American offices at 27 William Street, New York City. This enterprise has been approved by the State Department, the Department of Commerce and Labor and the International Bureau of American Republics, as well as by the Government of Chile, which is placing at the disposal of the company three buildings in the governmental park of the city of Santiago for the proposed exhibition. In view of the fact that England, France and Germany are now enjoying over 83 per cent. of the import business of South America it is believed to be an opportune moment to make an effort in behalf of increasing the trade of the United States in that part of the world.

—The architect of the National Government Building now being constructed at Buenos Ayres, has selected carborundum as the abrasive for cutting the marble to be used, and the plant of the Carborundum Company at Niagara Falls, N. Y., has just completed and shipped to the South American city four tons of carborundum marble working wheels. The carborundum wheels were selected for this important work only after the keenest competition with other wheels, and the letting of such a contract to the Carborundum Company is but another testimonial to the efficiency of carborundum as a marble cutter. The order included in all about one hundred and five wheels, varying in size from 26 inches to 14 inches in diameter, and the shipment when completed weighed exactly four tons. This is believed to be the largest single shipment of any abrasive wheels ever sent to South America.

—DuBois Iron Works, manufacturers of "DuBois" gas engines and steam and power pumps, have been awarded the contract for the complete equipment and installation of a pumping station for the Clarion Water Works, Clarion, Pa., the machinery consisting of one 150 H. P. "DuBois" tandem natural gas engine geared to a million gallon pump, and one 50 H. P. unit for driving air compressor, one centrifugal pump, together with all necessary fittings, etc. The plant is installed as an auxiliary to the present steam pumping equipment, which will eventually be replaced by a duplicate of the new gas engine driven unit. The engines and pumps will work against a head of 685 feet, pumping through 4,000 feet of 10-inch main to the stand-pipe. A complete new power station is being erected and the plant when finished will be one of the most efficient and modern of its kind in the country. The DuBois Iron Works has also been awarded a contract for a 160 H. P. twin tandem gas engine, direct connected to 100 KW. generator, for the lighting plant of the Seventy-fourth regiment state armory building at Buffalo, N. Y.

—One of the many evidences of the return of prosperity is found in the fact that the Carborundum Company, manufacturers of Carborundum, is to increase its extensive plant at Niagara Falls by the addition of a four-story brick and steel structure, and the consequent increasing of its output and working force. The new building is to be 225 feet in length and 60 feet in width. One entire floor of the building is to be given over to the manufacture of Carborundum sharpening stones, hones, scythe stones and other specialties. The other floors will be used for the mixing and wheel moulding

departments and for storage room. During the past year the Carborundum Company has added several new lines to its manufactured products. These include garnet-paper and cloth, used largely in the wood and furniture trade, and emery paper and cloth, used in finishing metal and machinery parts. The addition of these lines and the development of the regular sharpening stone and grinding wheel business has made the addition to the plant necessary. Plans are under way to have the Carborundum Company cover the entire abrasive field with its products, and as these plans mature they will result in a still larger plant and a greater working force.

—The William B. Scaife & Sons Co., Pittsburg, Pa., manufacturers of the We-Fu-Go and Scaife water softening, purifying and filtering systems, have found it necessary to build an addition to their present plant at Oakmont, Pa., to accommodate their increased business in the building of systems for the purification of water for steam boilers, industrial and domestic uses, and are about to begin the erection of a shop 40 ft. by 200 ft., equipped with the latest improved machinery, which, in addition to their present shops, will be used for manufacturing the We-Fu-Go and Scaife systems. They have under construction at the present time for steam boiler plants systems aggregating 95,000 H.P. in addition to plants for softening and clarifying water to be used in manufacturing processes such as dyeing and bleaching in woolen and cotton mills, and for washing in laundries, as well as a number of mechanical gravity filter systems for manufacturing and domestic use. Among some of their recent contracts are the following: Pittsburg-Buffalo Co., Canonsburg, Pa., 1,000 H. P. System; Merchants' Ice & Cold Storage Co., Terre Haute, Ind., 750 H. P. System; Auburn & Syracuse Electric R. R. Co., Auburn, N. Y., 750 H.P. System; Columbia Plate Glass Co., Blairsville, Pa., 3,000 H.P. System; John A. Manning Paper Co., Troy, N. Y., 750 H.P. System; Natrona Water Co., Natrona, Pa., 500,000 gallon mechanical gravity filter system; Edwards & Chapman (laundry), Springfield, Ill., 3,000 gallon per hour system; Jenner-Quemahoning Coal Co., Holsopple, Pa., 6,000 gallon per hour system, boilers and town supply.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Boilers.

GEM CITY BOILER CO., Dayton, Ohio.—A brief illustrated catalogue of horizontal tubular boilers giving standard specifications for the boilers, fixtures and fittings.

Boiler Tube Cleaners.

LAGONDA MFG. CO., Springfield, Ohio.—Small pamphlet illustrating the Weinland turbine boiler tube cleaner.

Cranes.

PAWLING & HARNISCHFEGER, Milwaukee, Wis. —Very extensive and finely illustrated catalogue showing many types of traveling cranes for both indoor and outdoor service.

Concrete Mixer.

CONTRACTORS SUPPLY & EQUIPMENT CO., Old Colony Building, Chicago, Ill.—Catalogue of the Smith concrete mixer, showing the construction of the drum and the many types of this machine.

Concrete Reinforcing.

AMERICAN SYSTEM OF REINFORCING, Chicago, Ill.—Pamphlet showing the "American" system of reinforcing for concrete, consisting of plain round rods underneath woven wire fabric, both of high carbon steel. The contention is that plain round bars give results quite as good as deformed bars, having the same elastic limit. Round bars are of course the more economical.

EXPANDED METAL AND CORRUGATED BAR CO., Frisco Building, St. Louis, Mo.—A very handsomely illustrated catalogue of corrugated bars for reinforced concrete construction. It is contended that in such a bar as the "corrugated" with square shoulders, at frequent intervals along

its length, which come into action immediately upon the application of stress, and develop their full efficiency with absolutely no movement, the greatest strength is attained.

Derricks.

TERRY & TENCH CO., INC., 131st St. and Lexington Ave., New York City.—A large catalogue of derricks and derrick fittings, with many illustrations of the parts and interesting installations.

Drills.

STANDARD DIAMOND DRILL CO., Chamber of Commerce, Chicago, Ill.—Catalogue illustrating and describing the "Standard" diamond drills for removing solid cores through rock for prospecting. A great deal of information is included in this book.

Electric Motors.

ROBBINS & MYERS CO., Springfield, Ohio.—"An Information Book" of the "Standard" motors for direct-current circuits, showing these motors in all types and sizes and illustrating their adaptation to several specific machines.

Electric Motors.

TRIUMPH ELECTRIC CO., Cincinnati, Ohio—Extensive catalogue showing a line of motors and generators with their applications in the machine shop, the printing house, the wood shop, rolling mills and several miscellaneous applications.

Engines, Steam.

MCINTOSH, SEYMOUR & CO., Auburn, N. Y.—Descriptive catalogue of many installations of steam engines built by McIntosh, Seymour & Co. The distinctive features of these engines are their positively driven flat gridiron valves, arranged to give small clearance space, the interheating receiver, and a powerful governor mounted directly upon the main shaft, which regulates the speed of the engine by changing the position of the eccentric which drives the cut-off valves. The object of these features is to secure a still lower consumption of steam than that obtained with the Corliss and similar economical types of engines, especially a more sustained economy without deterioration from wear of valves, and to obtain a closer and more certain and reliable regulation of the speed and a valve-gear which will run at any speed.

Feed-Water Heaters.

LOEW MANUFACTURING CO., Cleveland, Ohio.—Bulletin describing in detail the Loew boiler feed-water heater, together with the Loew steam separators, oil separators, and the "Victor" pipe machine.

RUSSELL ENGINE CO., Massillon, Ohio.—Pamphlet showing in detail the Massillon feed-water heater, purifier and oil extractor. The aim in designing this heater was to make one with all parts of easy access so that the work of cleaning and recharging is reduced to a minimum.

Gas-Blast Furnace.

CHICAGO FLEXIBLE SHAFT CO., La Salle Ave. and Ontario St., Chicago, Ill.—Illustrated catalogue showing the many types of Stewart gas-blast furnace adapted to different kinds of gas—illuminating, natural, or gasolene gas. They may also be had for burners for crude oil or petroleum. The claim is made that the form of burner used in this furnace produces perfect combustion, making no smoke, soot or odor. The furnaces need not be connected with chimney.

Metal-Melting Furnaces.

HAWLEY DOWN DRAFT FURNACE CO., Chicago, Ill.—Extensive catalogue showing types and testimonials from users of the Schwartz metal-melting and refining furnaces, using crude oil, fuel oil, or gas for fuel. This furnace is built in sizes ranging from 100 to 20,000 pounds per heat. No crucibles are required.

Milling Machines.

KEMPSMITH MANUFACTURING CO., Linus and Woodward Sts., Milwaukee, Wis.—Loose-leaf catalogue of Kempsmith milling machines and attachments, showing a line broad enough to meet almost any demand of modern milling practice, embracing plain and universal, positive feed and belt feed, belt and motor driven, milling machines, and vertical, circular, universal, high speed, and slotting attachments, dividing heads, index centers, vises, arbors, collets, cutters, etc.

Pumps.

DEMING CO., Salem, Ohio.—A new catalogue giving details of spray pumps, nozzles and appliances, and a very complete spraying chart. Spray pumps of the pattern here illustrated can be used to advanatge for whitewashing in mills, factories, warehouses, etc.

DAYTON HYDRAULIC MACHINERY CO., Dayton, Ohio.—An illustrated catalogue showing the Dayton turbine pumps for general service, boiler feeding, mine drainage, and underwriters fire service. Appended to this catalogue are several reference tables of great value to the engineer.

Steam Traps.

MOREHEAD MFG. CO., Detroit, Mich.—An illustrated pamphlet in two colors, showing in detail the Morehead tilting steam trap, both return and non-return. In addition to illustrations of actual installations there are many diagrams showing piping.

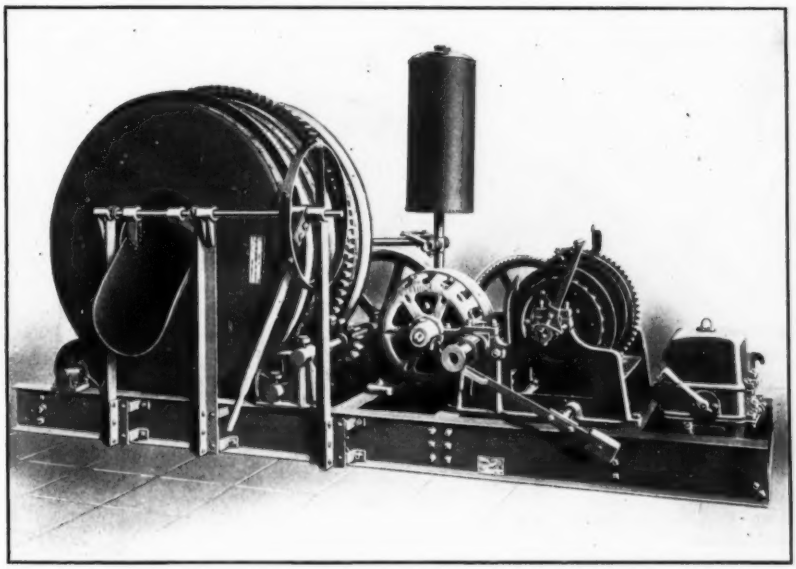
Turret Lathes.

INTERNATIONAL MACHINE TOOL CO., Indianapolis, Ind.—Portfolio giving description and specifications of the "Libby" full swing turret lathes. The new features are full swing over carriage, rapid power traverse for both carriages, geared headstock, quick change feed gears and speeds, indicator for position of cutters, automatic feed trip offs, very coarse feeds, very fine feeds and ease of changing from belt to motor drive.

THE CURRENT RECORD OF
IMPROVED MACHINERY
NEW METHODS NEW MATERIALS
NEW APPLIANCES

Motor Driven Concrete Mixer.

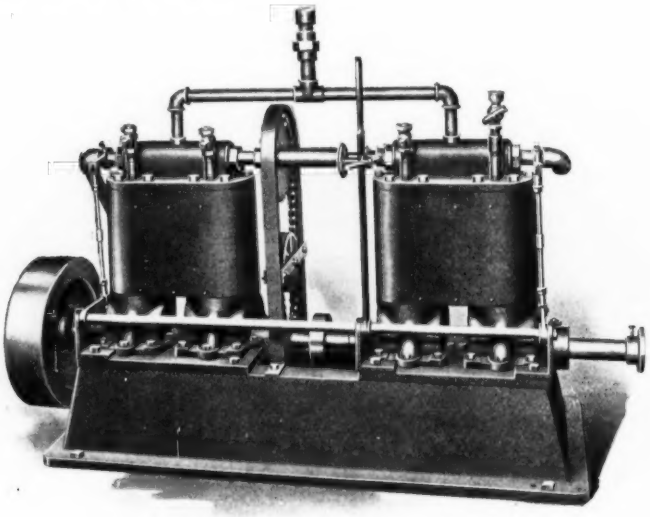
ONE of the most noteworthy buildings of reinforced concrete construction is that being bult for the Sacramento Hotel Company, Sacramento, Cal. This building is designed to provide for catering to the demands of large conventions and legislative gatherings. Sellon & Hemmings designed the building, employing an architectural treatment tending to the Mission style. The structure covers a lot 160 by 140 feet, and consists of basement, first and mezzanine floors, and three floors for guests' rooms. In planning for the construction of this building, the Ransome Concrete Company of San Francisco, which is the general contractor, took pains to install an equipment which would be thoroughly reliable and durable, and also insure the rapid handling of materials. The principal element of the plant, the concrete mixer and hoisting machine, was especially designed for them by Norman B. Livermore & Company, San Francisco, to meet the requirements of heavy continuous service. The concrete machine



consists of a special combination Ransome concrete mixer mounted on a steel I-beam frame. On the end opposite the mixer is mounted a Mead-Morrison single-drum hoist. Both mixer and hoist are arranged to be driven directly through gearing by a 30 horse power Westinghouse alternating current motor operating at 850 rev. per min. on 200

volt, 60 cycle, three-phase current and equipped with the necessary auto-starter. The mixer is provided with a Ransome water-measuring device and a measuring hopper. The hoist is used in operating the Ransome concrete hoist-bucket. The whole arrangement forms a compact machine, the steel frame giving great stability to the outfit.

The mixer was set up in its permanent location in the basement under the sidewalk and retained in that location until all the concrete had been deposited in the building. Crushed rock and gravel were brought to the site by teams and dumped into large material bins from which it was fed by means of a belt conveyor to a large charging hopper mounted above the mixer. After mixing, the green concrete was hauled to the molds. That the arrangement as installed was an efficient one is demonstrated by a record of 381 cubic yards of concrete in 8¾ hours. This involved the mixing of 315 cubic yards of rock, 158 cubic yards of sand, and 572 barrels of cement; a total of 551 cubic yards of loose, dry material which weighed in the aggregate 1,427,000 pounds. The addition to this dry material of 460 barrels of water brings the actual weight of material handled to 1,547,600 pounds. The maximum haul for placing this concrete was 225 feet, the average haul, 150 feet. In doing this work but ten men were used in wheeling the ten carts, each man handling his cart alone and working the full day, so that the average amount of material placed by each during the day weighed over 75 tons.



A New Rotary Engine.

THE object of the Rothchild engine invention is to furnish an engine that shall have the economy of the most perfect type of present stationary engine, simpler in construction, and more convenient to operate than any engine of the reversible kind now in use. It differs from other inventions of this kind by being more economical, simple and reversible at the same time. The valves of this engine differ from others both as to location and movement. They are located in the cylinder heads and driven by a continuous rotary motion taken from the main shaft; the latter making three revolutions to one revolution of the valve. The valve is cylindrical in shape, and has three ports at equal distance on its circumference, thereby employing one

port for each revolution of the main shaft. The port in the valve casing is equal in width to the blank space between any two ports on the cylindrical valve. It will be seen from this that the engine can obtain steam by moving in either direction. The forward and backward movement of the engine is controlled by the cut-off within the cylinder valve. The cut-off separates the live steam from the exhaust, and its port arrangements are such that they control, in the most economical way, both the admission and exhaust of steam, according to the load or speed required. The cut-off extends beyond the valve casing far enough to permit the attachment of the controlling lever. The cut-off may be moved or changed at pleasure—without detriment to the exhaust—to expose the port either for a forward or backward movement of the engine, depending upon which way the cut-off is tilted. The position of the cut-off also controls the amount of steam to be admitted to the piston. By this construction it will be observed that there is a continuous rotary valve movement between a stationary case and a cut-off which may be varied to suit the occasion or circumstances. This enables the valve to enter unimpaired steam at a positive point for the piston to receive same. The variable cut-off inside of the cylindrical valve cuts off the supply of steam at any desired point of the stroke to suit the occasion, and may be operated by hand or governor. The seating contacts of movements contained in the valve are self-sealing and arranged so as to take up their own wear by differential pressure.

This engine differs from other cut-off engines in consequence of the continuous rotary movement of the valve, giving the latter a movement in one direction so that it can be met and regulated as to its steam admission with very slight movement of the cut-off, and this is only necessary when there is a change of load requiring a different amount of steam, or a change of direction requiring the reversing of the engine; otherwise the cut-off remains stationary. The entire control of the engine as to starting, stopping, regulating, or reversing, is done by one simple lever conveniently located to the operator. All joints and connections along the line of movements of the valve are of the toggle type, permitting an easy and flexible movement, also providing a thrust endways to make steam joints in place of stuffing boxes, and permitting the valve to seat without being interfered with by the motion of the stem. Further particulars of this engine may be had from the Rothchild Engine Co., 102 Centre street, New York.

Improved Method of Governing Pumps.

MOST pump governors are designed to maintain the water discharge pressure at a certain fixed point, but there are numerous conditions under which this uniform discharge pressure is not altogether desirable,—as in feeding boilers where the boiler pressure may vary. The disadvantage of a uniform high feed pressure is readily evident on marine boilers, where say, 250 pounds pressure is carried at sea and perhaps only 80 pounds while in port,—

just enough to operate the auxiliaries, etc. In these instances, unless the governors were frequently readjusted, pumps equipped with ordinary governors, would at all times tend to keep the feed line pressure over 250 pounds. The enormous surplus pressure on the feed line when the boilers were running on the lower pressures would tend to throw the feed water into the boiler with great force, would grind out the valves quicker, would make accurate feeding difficult, and the pumps would race whenever the feed valves were opened. The fireman or water tender, must also manipulate the throttle valve oftener, if there were no feed water controllers on the boilers. It would thus be difficult to maintain the correct water-level in the boilers and in addition to being noisy, the pumps would wear unduly. The conditions are similar in the case of rolling mill boilers, although here the pressure may not vary between such wide limits. The powerful engines start, stop and reverse with every pass of the ingot through the rolls so that the steam consumption is highly irregular. As a consequence boiler pressure varies incessantly and the water line would be unstable if it were attempted to maintain it by constant feed line pressure. The constant pressure would necessarily be at too much excess when the boiler was under the lower pressures or too low when the boiler pressure was high.

In cases like these it would be highly desirable if the governor maintained the feed line pressure at just the right excess at all times to make the flow into the boiler regular. This would hold true in any boiler plant where the pressure varies.

We illustrate herewith a self-contained governor, without outside parts exposed to tampering and which never requires any adjustment and which keeps the pump discharge pressure always at a fixed excess of about 15 pounds over the boiler pressure, regardless of variation in steam consumption, boiler pressure, or the amount of water being supplied to one or more boilers.

Going back to our marine example, the great advantage of this governor is readily seen in the case of ferry-boats which on account of the short trips are not usually provided with much reserve steam capacity. We will say a certain ferry-boat leaves the dock with boilers under 250 pounds pressure, and is making a trip against the tide and in winter possibly against ice-floes. The governor at the start maintains 265 pounds pressure in the feed line. As the boat proceeds the boiler pressure may drop to say 90 pounds before arrival at the boat's destination. During all this time as the pressure has been dropping, the feed line when controlled by a Foster governor, drops to the 15 pounds excess limit so that there will be but 105 pounds pressure on the line at the end of the trip.

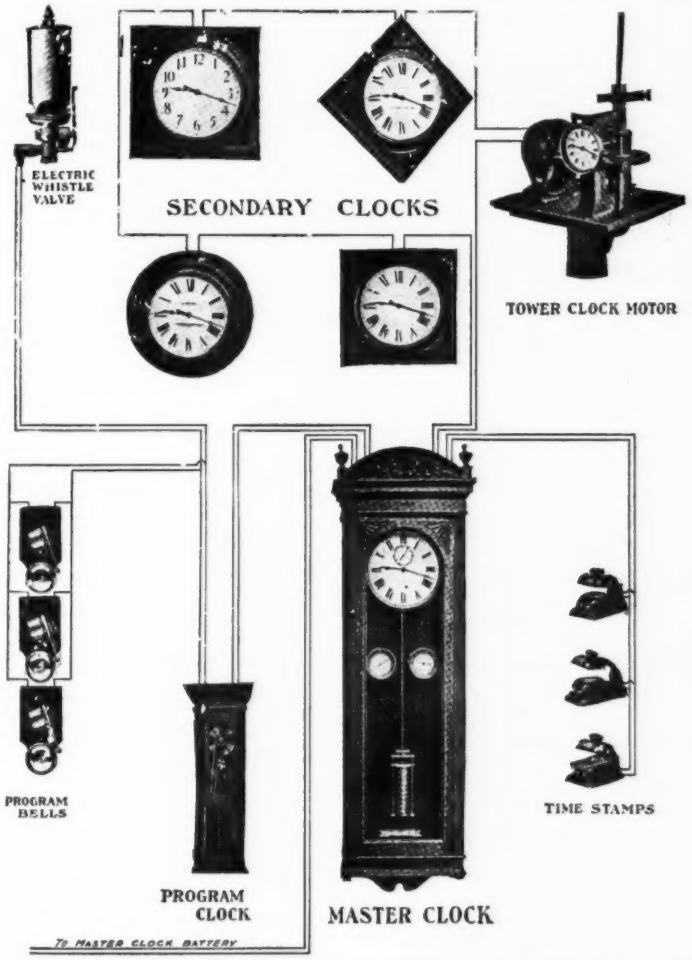
This Foster "excess" governor was patented January 19, 1909, but has been tested thoroughly by a year's continuous service and found to be very regular in its operation. Once connected, the governor does not have to be touched as the complete and final adjustment is determined by the proportions of one of the internal parts, not by the adjustment of springs or counterweights.

The Foster Engineering Company, of Newark, N. J., are the sole manufacturers of this device.

Electric Time Systems for Industrial Plants.

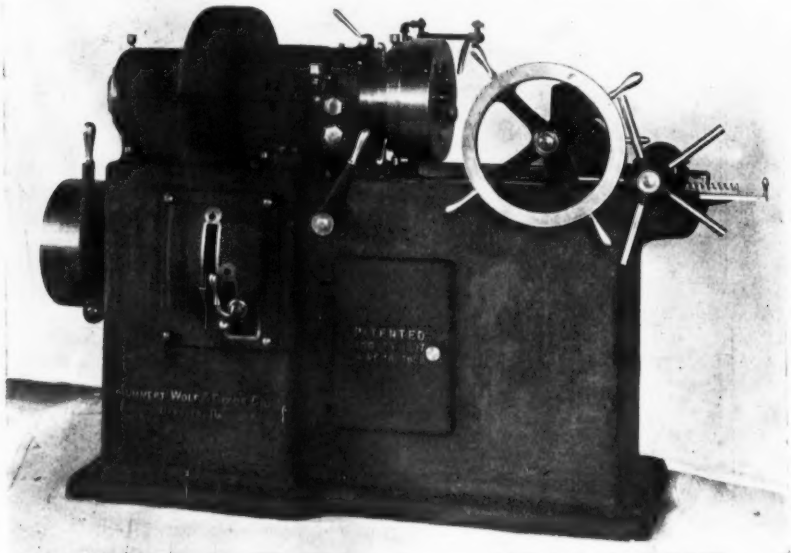
THE reasons for the electric systems of distributing time in industrial plants are mainly economic ones born of modern competition conditions. The cost of labor and machine work in this country is such that it behooves the manager, who would survive competition to exercise eternal vigilance in economizing time of both men and machines; *i. e.*, making every minute of the working day effective. He must also have a sure basis for obtaining time cost and a means of checking actual time required against the standard time determined for any particular job. Furthermore, there may be a marked difference in the attitude of workmen with respect to the use of time. In one plant they may be careless, slipshop, haphazard, and wasteful, while in another they are alert, precise, well co-

ordinated and economic. To foster this latter condition is really one of the chief advantages of the electric time installations in industrial plants. The heart of the system is an electric self-winding master clock which is so made and compensated as to run accurately to within a few seconds per month. It is connected electrically with every other device in the system so as to keep time for the whole. For example, the master clock will control any number of secondary clocks located in various departments or group of buildings, so that each secondary clock will absolutely agree with the master clock, and therefore with every other secondary clock in the system. This accuracy and synchronism of time indications is impossible with independent, winding, clocks even of very expensive construction. But the distribution of synchronous time indications is only one function of an electric system. Another useful feature is the "program" or schedule clock, which is capable of automatically actuating schedules of bells, gongs, or other audible signals in any number of locations desired. One pro-



gram clock is capable of controlling from one to eight separate sets of schedules or circuits of signals, and will also change automatically the schedules for different days of the week, as may be necessary for any particular business. It may also be used to blow the starting and stopping whistle automatically. These audible signals in departments, offices, etc., make possible precision in the use of time in starting, stopping and timing operations, and facilitates the harmonious and concerted action of large bodies of men so that a direct improvement in discipline and precision ensues. Time stamps, time registers, machines, or any other timing equipment may also be controlled through the same master clocks. The operation of an electric system is quite automatic, since it is driven by a primary or storage battery requiring renewals only once every fifteen or eighteen months. The secondary clocks in the system do not have to be wound, regulated, set or oiled, so they may be located permanently at the most convenient points for observation without reference to their accessibility. The mechanism of each clock is only that necessary to drive the hands forward one minute when actuated by an electrical impulse sent out from the master clock on the minutes.

The accompanying figure illustrates diagrammatically the relations of some of the usual elements in a "Standard" time system as presented by the Industrial Instrument Company, Foxboro, Mass. This company has gone into the matter of economics of electrical time systems for industrial plants in a quite exhaustive manner, summarizing some of the results and data in a new bulletin, No. 22, which may be had on request.



Plurality Bolt Cutter.

THE Plurality high power bolt cutter is gear driven, taking its drive from a constant speed belt pulley, having within the pulley a friction clutch for starting and stopping the machine. A counter-shaft is not necessary for this machine. The speed variations are obtained from a set of tumbler gears which engages the main drive gear in the spindle. The change of speeds is easily got by moving the tumble gear handle so the required pinion comes in mesh with the large gear. The machine in general is very rigid and is carefully designed for high duty work as is required when high speed steel dies are used.

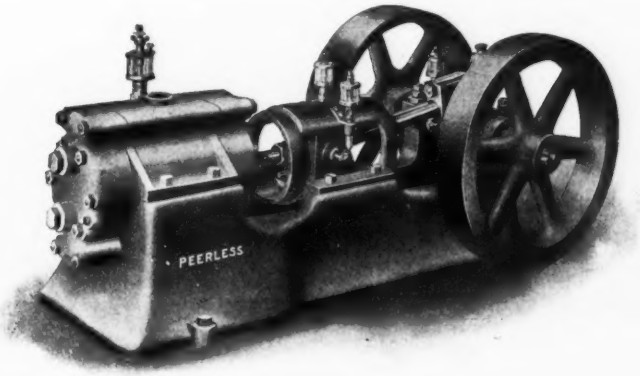
All gearings and the oil pump are en-

closed within the frame. The base has a solid bottom and is so constructed that it drains all the oil to the suction pipe of the pump. The oil-tank in the bottom of the machine is divided by an overflow division, which serves to catch all the metal particles which may be carried with the oil through the chip pan, the particles naturally settling to the bottom of the first division, while the top oil flows over the dividing ribs and is delivered to the pump in a fairly well filtered state, thus reducing the wear on the pump, as well as delivering a clean stream of oil on the dies when cutting. As the head is naturally flooded with this oil, if it were full of fine iron particles, this would eventually work into the wearing parts of the head and reduce its life to a certain extent.

The head of this machine is the regular Plurality die head with the Plurality dies. The head is either opened automatically or by hand. The dies can be adjusted while the machine is running, and they are also quickly changed from one sized thread to another without removing from the machine. With the graduated adjusting ring they can be set to cut the required diameter without the usual cut-and-try method ordinarily resorted to. The head when closed for threading is positively locked and is as rigid as a solid die.

The vise jaws on the carriage can be adjusted side-ways off the center when any irregular shaped piece is required to be threaded. When it is in the central position it is locked by a dowel pin.

This machine is built by Mummert, Wolf & Dixon Co., Hanover, Pa., who will be pleased to send fuller information on request.

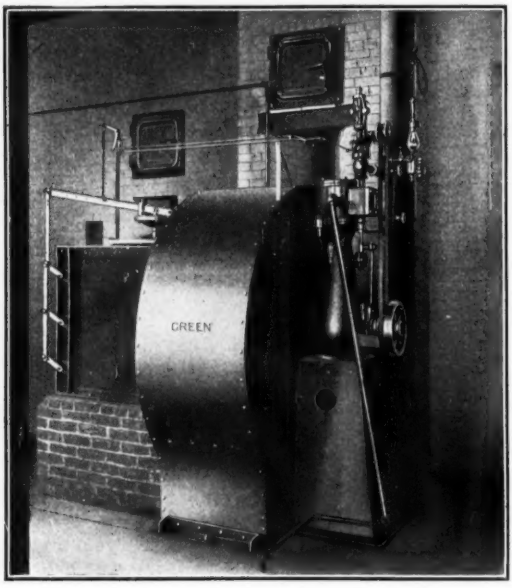


Peerless Air Compressors.

THE American Compressor & Pump Co., 26 Cortlandt street, New York, has just issued a new bulletin illustrative and descriptive of Peerless air compressors.

The accompanying illustration shows one of their type "F" belt driven air compressors. These machines are built in all sizes, single, duplex and two-stage, either belt, steam or electric driven. The salient features of "Peerless" air compressors are: They are built in the solid box bed-plate pattern and are therefore self contained, compact and rigid, requiring no special sub-base or sole-plate, and having no overhanging cylinders. These compressors are built to templates and jigs, and all parts are therefore interchangeable; the design is very simple, every working part is accessible. Each air valve and seat can be instantly removed from the outside, without the use of special wrench, and without disturbing any other portion of the machine. The air valve seats fit into the heads by means of ground joints, thus eliminating any special gaskets. The stuffing boxes are readily accessible for repacking. On

steam compressors, the steam cylinder heads are fitted to cylinders with ground joints. The heads can be removed so that the cylinder can be inspected when necessary and rings renewed without dismantling the machine. The crank shaft and connecting rods are made of the highest grade of forged steel, the latter having phosphor bronze boxes. The cross heads and guides are of the round type, with suitable adjustments and phosphor bronze shoes. The arrangement of the water jackets is such that the entire cylinder, head and air valves are water cooled. Belt air compressors are equipped with unloading governors of modern design. Steam machines are equipped with either speed governor or combined speed and pressure governors, as may be required.



Automatic Draft Control for Steam Boilers.

IT is claimed that the automatic draft control system illustrated herewith unites the desirable qualities of forced draft with those of induced draft. It so regulates the flue damper and the fan engine in combination that a neutral pressure is maintained in the furnace, just enough draft being supplied by the fan to propel the gases through the fire and by the chimney to draw them out through the boiler and up the stack. Moreover, as the apparatus is controlled by the steam pressure, it serves to maintain a uniform steam pressure at all times. As the result of maintaining a neutral draft in the furnace itself there is no leakage of air or gases inward or outward, no waste of heat occurs, either by escape of gases or infiltration of air, and the boiler setting is protected from overheating or chilling.

The apparatus used in this system of draft control consists of:

(1) two controllers actuated by steam pressure which admit water pressure to, or release water pressure from two systems of piping; (2) an actuator, operated by the hydraulic pressure from one controller, which opens and closes a damper in the discharge opening of the

blast fan; (3) a diaphragm valve, or a piston valve, operated from the same controller which admits or cuts off the steam supply to the fan engine, or which, by suitable means, controls any other source of power used; (4) an actuator operated by the hydraulic pressure from the second controller, which opens and closes the damper in the chimney flue and which is adjusted to open a little ahead of the damper and to close a little later; (5) a centrifugal blast fan with engine or motor, or other variable speed drive; and (6) independent, hand-adjusted dampers, admitting air from the blast fan conduit to the individual ash-pits.

The controller, located near the forced draft fan, admits water pressure to a line of one-half inch pipe running to an actuator, which operates a damper in the chimney flue. A second controller admits water pressure to an actuator or damper motor which operates louvre dampers in the discharge of the fan. This same controller admits water pressure to the diaphragm or piston valve which controls the admission of steam to the engine and slows down the engine driving the fan at the same time that the fan outlet is throttled. By controlling the speed of the fan a considerable economy in steam for driving is effected. The chimney flue damper is arranged to close a trifle earlier than the fan dampers to avoid the possibility of any gas being forced out through the fire doors by the operation of the blast fan

This automatic draft control apparatus should not be confused with the various steam blowers, steam turbines, and other similar appliances for similar work. The main objection to these devices is the quantity of steam they consume, which in the case of a battery of boilers may be much larger than the steam consumption of a single engine driving a large fan. Moreover the steam injected into the ash pits is detrimental in another way, since in passing through the fire it is superheated, acting in this respect like surplus air and carrying a certain amount of heat out the chimney.

The system of draft described above is installed by the Green Fuel Economizer Co., Matteawan, N. Y.

Blake & Knowles Feed Water Heater.

TO attain high efficiency of feed water heating the heating steam and the water to be heated must be kept in motion at a considerable and uniform speed, and the changes in direction of flow shall result in counter currents of steam and water in close contact, and be so directed as to compel the greatest transfer of heat

possible. Tests have shown that a heater designed with little regard for the right direction and speed of flow must be considerably larger and, as a consequence, heavier and more expensive than an apparatus for the same service which is properly designed and constructed. This makes it a matter of concern to both the buyer and the user, bringing in as it does, the question of capital invested and the weight and space occupied by the

equipment. In the selection of a heater it is important, therefore, that heat-transferring efficiency be carefully considered. The old statement that quantity of heating surface determines the capacity of a heater is erroneous. The essential thing is the proper directing of the moving currents and the speeds at which they shall flow. These conditions are perfectly met in the construction of the Blake-Knowles heater, and comprehensive tests show clearly their high efficiency.

The interior of the shell, through which the steam passes, is divided by longitudinal partitions in which the water tubes are arranged so that the steam flows the entire length of the shell, in close contact with these tubes, three times before finally passing out. The water tubes are securely expanded into the tube heads, one of which is a part of the main casting, while the other is bolted to a flexible diaphragm, the periphery of which is fastened to the shell flange. This takes care of the tube expansion and makes unnecessary any troublesome stuffing boxes for the individual tubes. These water tubes are of small diameter, so that the heat passes quickly through the water, and six changes in direction of flow give the high water velocity essential for the best working results. Removal of the heater heads gives access to the interior, and the tubes are easily cleaned from the top end. These heaters are also made horizontal and are fitted with saddles in place of feet, as in the case of the vertical type, and they are built in a great variety of sizes covering the range of modern engineering demands. Further information in regard to the above heaters will be gladly furnished by the Blake & Knowles Steam Pump Works, of New York and Boston, who are the sold builders of this apparatus.

A New Transmission Chain.

THE fact that a driving chain could not conveniently be altered in length and that its links could not be replaced quickly, has to some been an objection against chain driving. The breaking of a chain or replacing of one link involved lost time and a repair job. The new Diamond chain which we illustrate overcomes this difficulty. Any link of this "Diamond Detachable," as it is called, may be taken out or a broken link in any part of the chain may be replaced without the use of special tools. Referring to the illustration, the thin strip steel lock on top of each outside link slips into a groove around the rivet surface, and turning on one rivet as a center, slips down into a similar groove on the other rivet, thus preventing the side bar proper from coming off. The strip is itself locked into position by being slightly warped inward, and having at its center an inward projection which snaps into a depression in the side bar. Once snapped into place the strip can't change its position unless an intentional upward pressure is exerted on the clip at the end. The hole in the side bar is so reamed that when the bar is locked into position, there is perfect bearing contact between the rivet shoulder and the side bar throughout the thickness of the bar. This chain will be made of the same materials, with the same accuracy, and will sell at the same price as the Diamond riveted chains. The links and parts of both will be interchangeable

with each other, and the detachable link may be used for repairing the other type of chain. The Diamond detachable chain has the evident advantages of neater appearance and narrowness, economizing space. The reduced width permits the chain to go into cramped places.

It may be added that chain drives are meeting with greater favor than ever in the last few years because of the great improvements in chain material and construction. There are conditions under which chain drives are superior to other driving methods, for their steady, even pull, slight elasticity, positive speed ratio and absence of initial tension are great factors to satisfactory service. On short drives there is not only a noticeable power saving over belting, but chain is easier on the machine bearings and the even motion is a protection to the edge of cutting tools. The new Diamond detachable chain is now being made in all standard sizes. Further information concerning its advantages may be had by addressing the Diamond Chain and Mfg. Co., Indianapolis, Ind., who will also send free their interesting book, "Chain Transmission of Power."

Personals.

—At a joint meeting of the four national engineering societies held in the auditorium of the Engineering Societies Building, New York City, on the evening of Tuesday, April the 13th, the John Fritz medal was conferred upon Charles T. Porter, honorary member of the American Society of Mechanical Engineers, in recognition of "his work in advancing the knowledge of steam engineering, and for improvements in engine construction."

This medal, it will be remembered, was established by the professional associates of John Fritz to perpetuate the memory of his achievements, and its award rests with a board composed of four members from each of the great societies—the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. The recipients of the medal since its establishment have been Lord Kelvin, George Westinghouse, Alexander Graham Bell, and Thomas A. Edison. Mr. Porter's work in his own field has been of a significance and a scientific and economic importance that make him a worthy associate of the distinguished company in which this year's award places him.

The presentation was made by E. Gybbon Spilsbury, Chairman of the Board 1908-9, by which the award was made, Mr. Porter being presented for the honor by Jesse M. Smith, President of the American Society of Mechanical Engineers. The presentation was preceded by an address by Dean W. F. M. Goss, of the University of Illinois, upon "The Debt of Modern Industrial Civilization to the Steam Engine," and followed by addresses on "The Debt of the Modern Steam Engine to Charles T. Porter," by Prof. F. R. Hutton; "The Debt of the Era of Steel to the High-Speed Steam Engine," by Robert W. Hunt, and "The Debt of the Era of Electricity to the High-Speed Steam Engine," by Frank J. Sprague.

—Jasper R. Rand, vice-president and director of the Ingersoll-Rand Company, died of pneumonia in Salt Lake City on March 30th. Mr. Rand was the son of Jasper Raymond Rand, one of the founders of the Rand Drill Company, and was born in Montclair, N. J., September 3, 1874. He was graduated from Cornell University in 1898 with the degree of Mechanical Engineer, and served in Porto Rico in the Spanish-American war as a member of the First New York Volunteer Engineers. During 1899-1900 he was president of the Imperial Engine Co., at Painted Post, New York, leaving that position to take the presidency of the Rand Drill Company, which he held until 1905. In that year he was elected vice-president and director of the Ingersoll-Rand Company, which was his chief interest until the last.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Abrasives.

NORTON CO., Worcester, Mass.—A complete catalogue of Norton products, such as alundum, grinding wheels, grinding machinery, glass cutting wheels, India oil stones, razor hones, scythe stones and rubbing and sharpening stones. A description of the production of Alundum is included in the first part of this catalogue.

Air Brakes.

WESTINGHOUSE AIR BRAKE CO., Pittsburg, Pa. —Instruction pamphlet No. 5030, entitled "The Type K Triple Valve."

Air Compressors.

AMERICAN COMPRESSOR AND PUMP CO., 26 Cortlandt St., New York.—Bulletin "A," showing many types of compressors. It is asserted that the Peerless single steam-actuated compressor for low pressures has great advantages over other straight line types in that it has solid cast iron bed-plate underneath the entire machine, being therefore self-contained and requiring no special sub-base. There are no overhanging cylinders, liable to spring, causing abnormal wear. Having a center crank with single connecting rod, the attendant difficulty of maintaining even lengths of side rods is avoided.

Automatic Stoker.

AMERICAN SHIP WINDLASS CO., Providence, R. I.—Catalogue showing the Taylor stoker, an inclined under-feed stoker in which green or uncoked fuel is fed under coked and burning fuel, while at the same time the entire fuel bed is moved by gravity down an incline in such a manner as to rid itself of ash and clinker. The air necessary to support combustion enters under pressure at a period between the coking and ignition of the fuel, and is so directed to the tuyeres as to produce complete combustion.

Belt Data.

J. A. & W. BIRD & CO., 14 India St., Boston, Mass. — A hundred page book entitled "Belt Talks" and abounding in information for the user of belting. The titles of the chapters are: Belt Drive Design; Notes on Belting; Quarter-Turn Drives; Strength of Shafting. The object is to present belt data of distinct value in solving the every-day problems of power transmission. (Price, 25 cents.)

Engineering Instruments.

KEUFFEL & ESSER CO., 127 Fulton St., New York.—The 33rd edition of the catalogue of Keuffel & Esser Co., which has just been published, is the largest as yet issued by them and will be of great interest to every engineer. Interspersed throughout the book are illustrations showing for the first time the interiors of the general office and factory buildings at Hoboken, N. J., which they now occupy, as well as views of the stores in New York, Chicago, St. Louis, San Francisco and Montreal. An important change in the general arrangement of the catalogue has been made by creating a special section for drafting-office furniture, which is now forming an important department among the goods manufactured.

Fire Brick.

HARBISON-WALKER REFRACTORIES CO., Pittsburg, Pa.—A pamphlet entitled "What Are Your Lime Kiln Costs?" in which is contained much valuable information for the user of fire brick in any form. The observations on the physical requirements of fire brick for different uses are well worth careful attention.

Heating Furnaces.

TATE, JONES & CO., INC., Pittsburgh, Pa.—"Oil *vs.* Coal," a strikingly arranged pamphlet on the advantages of oil fuel for heating furnaces, forges and steel melting.

Blowers.

AMERICAN BLOWER CO., Detroit, Mich.—Catalogue dealing principally with the Sirocco blower; comparisons of the Sirocco turbine wheel with the steel plate fan wheel; capacity tables, etc.

Lubricators.

GREENE, TWEED & CO., 109 Duane St., New York.—A new booklet giving a list of all the different sizes of lubricators made by this firm, including the new two-pint and half-gallon sizes. All parts of this line of lubricators are made of steel and all bearings are case-hardened. All the mechanism of the latest improved Rochester automatic lubricators is contained in a steel pump block. This block with all the mechanism attached can be easily detached and removed, giving convenient access to all the working parts for cleaning, repairing, etc., without disturbing the bowl or reservoir attached to the engine. —The principal working parts are enclosed and protected from dirt, grit, etc.

Track Supplies—Railway Material.

BUDA FOUNDRY & MFG. CO., Railway Exchange Building, Chicago, Ill.—Illustrated catalogue No. 127 describing water softening plants, railroad motor cars and velocipedes, jacks, switch stands, crossing gates, frogs, crossings, switches, track drills and a full line of scales.

Valves—Gate, Globe, Angle, Check.

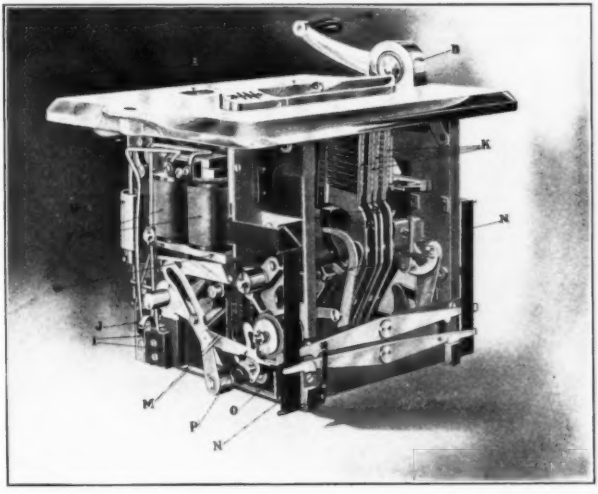
NELSON VALVE CO., Chestnut Hill, Philadelphia, Pa.—This catalogue shows gate, globe, angle and check valves in large variety of various metals. Among the new features are included newly patented bronze swing check valves, and hydraulically and electrically operated gate valves. The listing of steel gate and globe valves, for high pressures and superheated steam, marks a new era in high class valve construction. Another new departure of note is the listing of open hearth steel fittings. The use of engravings showing both inside and outside views, is generous; the descriptive articles and dimensioned lists immediately opposite the engravings facilitate easy and critical study of each of the valves. Test pressures as well as the working pressures are in each case given, so that the valve user has a definite basis for selection of the valve he wants.

THE CURRENT RECORD OF
IMPROVED MACHINERY
NEW METHODS NEW MATERIALS
NEW APPLIANCES

New Elapsed Time Recorder.

FOR years there has been a demand for a machine that would accurately compute and print in plain figures the elapsed time on different jobs. Until now no such machine has been available. After four years of experiments and actual working tests the International Time Recording Company of New York, located at Endicott, N. Y., have completed a machine which will do this work. The machine is electrically operated and an unlimited number of mechanisms can be actuated and governed by a single master clock.

This machine is designed for none other than cost purposes. It is not intended as a time recording device for in and out time. Other machines do this perfectly and do not require description here. The International Elapsed Time Machine prints the starting time, the stopping



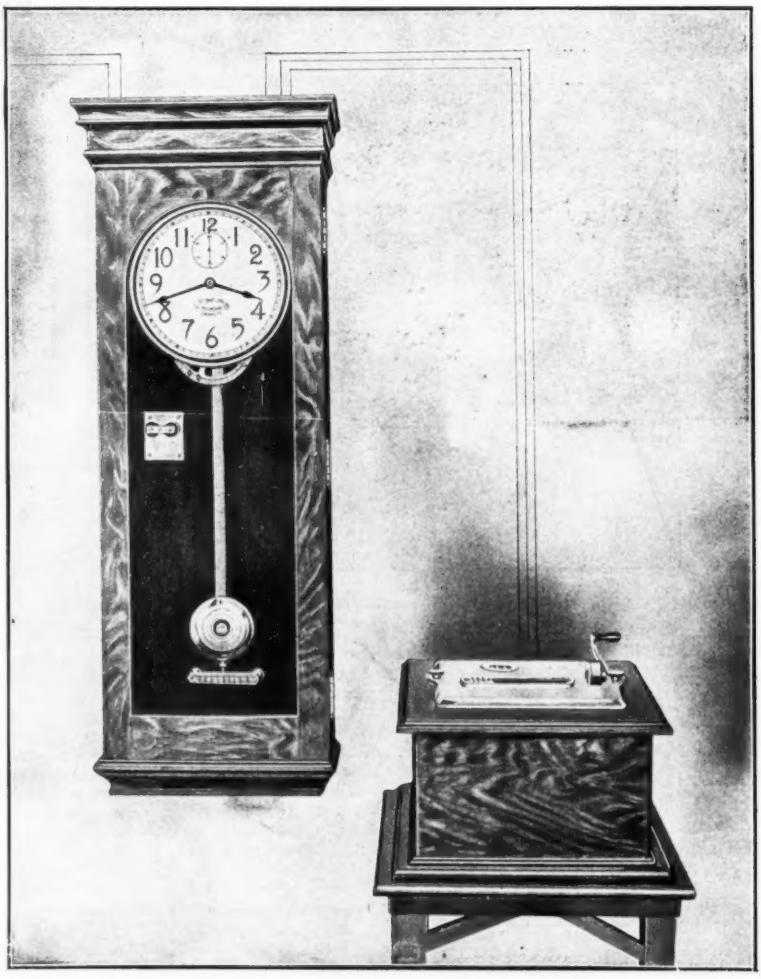
MECHANISM OF INTERNATIONAL ELAPSED TIME MACHINE.

A, operating handle—B, housing enclosing gear that operates recorder—C, card receiver slot for "in" registration—D, card receiver slot for "out" registration—E, time of day indicating wheels—F, magnets—G, armature operating time of day indicating wheels—H, oil dash pot for controlling action of armature G—I, electric contact points connecting magnet to master clock and batteries—J, electric contact point for noon hour and night cut out device—K, selector pins for finding holes which have been punched through card (these pins also stop toothed racks which aid in locating time printing wheels to proper elapsed time)—L, finder that passes through notch in end of card allowing elapsed time printing pad A to operate—M, toothed racks which aid in locating printing wheels to proper elapsed time—N, inking ribbon—O, lever that automatically changes direction of ink ribbon feed—P, ribbon feed pawl—Q, elapsed time printing pad—R, time of day printing pad.

time and the elapsed time in plain arabic numerals on one line. There can be no mistake about the accuracy of the result as it is mechanically impossible for the machine to err. Nor is it possible to place the card in the machine so that an incorrect result is obtained.

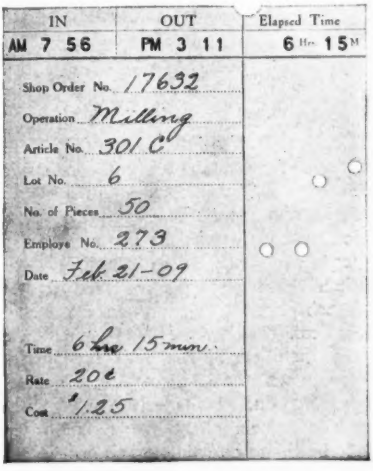
The record may be in one of three forms as selected by the purchaser of the machine as follows: hours and minutes, hours and tenths and hours and hundredths. The starting and stopping time, however is always printed in hours and minutes irrespective of the form of the elapsed time.

The device is operated electrically, as stated above, the impulses being furnished by a master clock. This may be located anywhere in the building, preferably in the office, as it will be less affected by vibration and dust. To the master clock is also fitted the 24 hour



INTERNATIONAL ELAPSED TIME RECORDER AND MASTER CLOCK.

elimination or cut-out wheel which will be described later. This clock transmits electric impulses each minute all through the building to the various elapsed time mechanisms. Thus all the machines are exactly the same time and cards may be registered in on one machine and out on any other and correct results obtained.

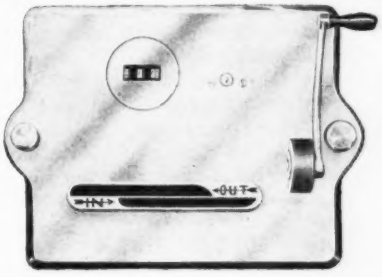


FAC-SIMILE OF RECORD CARD MADE BY INTERNATIONAL ELAPSED TIME MACHINE—HALF SIZE.

The mechanism is about 9 inches square and is enclosed in a dust proof iron case. It may be placed on a work bench, on a pedestal or it may be sunk flush with the top of the bench or desk. The flat cover has two openings or slots for the insertion of the cards. One opening is marked "in" for the first record of a job, the other "out" for registering when the job is completed. There is also an aperture in the cover through which may be seen a series of indicating wheels showing exactly the time of day. There is only one handle to be operated and, therefore, no confusion can occur in the mind of the operator as to which handle to pull.

The cards used in the machine may be of any length desired but can only be of one width, 4¼ inches. In registering in the card is placed in the front or starting slot and the lever pulled over. This prints the starting time at the top of the card in the space to the left. At the same time four small holes are punched in the card which individualize the record. After a job is completed the card is placed in the rear or stopping slot the lever pulled over once more and the stopping time and actual elapsed time are both printed on the card by one pull of the handle, thus enabling anyone to compare the two records and prove the accuracy of the machine for every record.

One of the salient features connected with this device is its ability to compute only the actual time worked in the factory irrespective of the times of registration. That is to say, in a factory working ten hours a day from seven to twelve and one to six the elapsed time will only be computed during these hours. Any registrations made before seven o'clock will not begin to count elapsed time until that hour, and the computation of elapsed time automatically stops at noon to be resumed at exactly one o'clock and then continues until quitting time at night, when again it stops automatically. The clock movement, however, does not stop, but always shows the correct time exactly the same as the master clock and is entirely unaffected by the elimination of the non-working hours in figuring the elapsed time. The machine can also be set to record overtime at night if so desired.



TOP VIEW OF ELAPSED TIME MACHINE SHOWING "IN" AND "OUT" SLOTS AND TIME OF DAY INDICATING WHEELS.

In case work on a given job is not completed on the day it is begun, it is not necessary to ring out on the elapsed time machine until the job is completed as the

machine computes up to 100 hours. A job beginning on Monday and running through the week until Saturday night, when it is finished, may be registered on one card, or even for a longer period up to 100 hours.

The elimination or cut-out wheel referred to in a former part of this article as being a part of the master clock, is responsible for this wonderful piece of work. The wheel makes one revolution in twenty-four hours and is graduated in fifteen minute divisions for the purpose of setting the contact breakers. The contact breakers are bits of hard rubber which are fastened around the rim of the wheel and may be moved about at the will of the custodian of the apparatus by simply loosening the set screw. These blocks are set on the starting and stopping time and when they pass the contact breakers the electrical circuit is broken and the computing device started or stopped as the case may be.

On the International Elapsed Time Machine the registrations may be made as soon as the workman is ready to go to work, irrespective of the actual starting time, and, therefore, no time is lost by the workman waiting for a chance to ring in, but the elapsed time will only be figured from the hours when the men should actually begin work. For example—a workman might register on his job ticket at ten minutes to seven o'clock, but the elapsed time would only be calculated from seven o'clock, the actual time of beginning work.

The machines are wired in multiple and any number of machines may be operated by one master clock. Machines may be added or removed from the circuit without interfering with the working of the other machines. A most severe and exhaustive test of these machines has been made by one of the largest corporations in this country and a very favorable report made covering every detail of the mechanism.

The value of this machine to any manufacturing business is at once apparent. The red tape surrounding the cost department is done away with. There are no deductions to be made from the elapsed time as indicated on the job cards. Nothing remains to be done but to post the time to the proper order sheet and compute the amount earned. The data thus obtained is absolutely accurate. No chance for any of the ordinary mistakes. The work in the cost department is so largely reduced that the services of cheap clerks who usually make the expensive mistakes can be dispensed with.

Wing Blower Installation.

THE following is a description of the installation of the Wing turbine blower system of mechanical draft at the boiler plant of the New York Telephone Company. The plant consists of four 125 H. P. Babcock & Wilcox boilers and two 250 H. P. Edgemore boilers placed in separate batteries. Each boiler is equipped with a separate blower, a 16-inch blower being installed in the side ash pit wall of each of the Babcock & Wilcox boilers, and a 20-inch blower being installed in the rear combustion chamber wall of each of the Edgemore boilers, a duct being run through the combustion chamber and through the bridge wall to convey the air to the ash pit. There being a separate blower for each boiler, they are absolutely independent of one another, so that in the event of running four boilers out of the six, which is often the case, only four blowers are run, thus giving absolutely individual control. When cleaning fires and hauling out ashes, individual control is especially advantageous, as the blower supplying air to that particular boiler is shut down. In a plant having one blower to supply all the boilers, at the cleaning of the fires the blower engine is not shut down, but the damper or gate in the particular duct supplying air to that certain boiler is closed during that time, forcing all the air that would be supplied to the other boiler, into the ashpits of the remaining boilers, greatly increasing the ash pit pressure and forcing excess air and exhaust steam through the other fires, causing very imperfect combustion.

The entire system is operated automatically, so that the speed of the blowers is varied according to the steam pressure—*i. e.*, when the steam drops about a

pound the blowers at once pick up in speed and on getting up to normal or nearly so, slow down or stop.

The hand dampers are set at such a point that when the blowers are running at normal speed and the proper rate of combustion is taking place in the furnace there will be no in-rush of air through the fire doors when they are opened, and there will be no gases coming out. In other words, atmospheric pressure is carried in the furnace all the while the fans are running, resulting in great economy, and increased boiler capacity without straining the boiler in any way, as the heating surface is more evenly utilized. The saving effected in this plant is about 20 per cent and an increased boiler capacity of 60 per cent.

Another feature of this installation is that the heat that hangs over the top of the boilers is drawn down by the blowers, thus furnishing the air a great deal hotter, saving, of course, a certain amount of heat that would be required in the furnace to raise the temperature of the air to that extent. Ventilation of the boiler room is also obtained in this way.

The blower system above described was installed by the L. J. Wing Mfg. Co., 1011 West St. Bldg., New York, who will be pleased to furnish further particulars upon request.

Wagner Single-Phase Motors.

EVERYONE connected with the electrical industry has had occasion some time or other to lament the fact that a commercial motor of the single-phase type did not make its appearance simultaneously with the polyphase motor. In a recent paper read by the manager of the small motor department of one of the large electrical manufacturing companies this fact is expressed with particular aptness: "As means for enlarging the field for the use of electric power, especially in small industries located in suburban towns or on the outskirts of large cities, the modern single-phase motor occupies a unique and unassailable position and is held in ever-increasing regard by those who appreciate and cultivate the many adavantages to be derived through its use. If at that period when the alternating current system was just making its way to the front there had been a thoroughly reliable and satisfactory single-phase motor available, it is altogether probable that the extraordinary development of polyphase apparatus and distribution might have been considerably affected and probably postponed thereby."

Fifteen years ago the Wagner single-phase motor made its début. For many years, however, its adoption was comparatively slow, due in part to the opposition to single-phase distribution by manufacturers unable to supply commercial single-phase motors. To-day, however, its advent is recognized as of very great importance and value to electric power producers and electric power users. Wagner motors to-day operate upon the same principle as the original Wagner single-phase motors. Improvements have been introduced, new types added, new adaptations made, and changes in the methods of executing certain functions effected from time to time, but without change in the elementary principles of repulsion start and induction operation. The first motor shipped by the Wagner company has been destroyed by fire; the second and sixth are now in its exhibition room. The fourth and thirteenth are now in service in Logansport, Indiana. The twenty-ninth was recently located at Hookset, N. H., where, barring a slight accident in moving, it has cost nothing in repairs and has been doing its work without interruption for fifteen years.

The Wagner single-phase motor is an induction motor having a commutator mounted on the rotor shaft and connected to the rotor winding. Starting with the machine at rest, brushes in pairs, cross connected through a low resistance conductor, bear upon the commutator, temporarily short-circuiting the rotor winding and developing a very powerful starting torque on the "repulsion" principle. On attaining full-load speed, by the operation of an automatic centrifugal governor the individual segments of the commutator are all positive-

ly connected together, thereby transforming the rotor winding to the squirrel-cage form; the motor then continuing as an induction type machine. The governor at the same time removes the brushes from contact with the commutator, to save wear. No harm can be done the Wagner single-phase motor by suddenly interrupting, or without the intermediary of resistance suddenly reestablish the circuit at any stage of the cycle of its operation from rest to full speed, irrespective of load conditions. If the power service should fail for any reason, the motor returns to the starting condition, and picks up its load when the power comes on again, without the assistance or attention of the operator. The greatest difficulty in the use of alternating current motors upon lighting circuits is in the disturbance produced at the moment of starting. Polyphase motors of the squirrel-cage type take from three to eight times normal current at the instant of starting when full normal torque is required, and if this current is at low power factor considerable disturbance will result unless the feeder and transformers are both of ample capacity. For a given torque, Wagner single-phase motors disturb the one phase from which the entire power is taken less than the usual polyphase motor disturbs every phase. The actual currents per line wire for full-load torque in motors wound for 220 volts is shown in the following tabulation:

	Amperes per line wire			
	5 H.P.	7½ H.P.	10 H.P.	15 H.P.
3-phase squirrel-cage with auto-starter	54	80	105	140
2-phase squirrel-cage with auto-starter	50	75	98	132
Wagner single-phase without starting box	45	68	80	125
Wagner single-phase with starting box	33	50	65	90

It is interesting to note in this tabulation that the starting currents required for single-phase motors without starter are favorable as compared with polyphase motors, and that when starter is employed the advantage in the matter of line disturbance is greatly in favor of the Wagner single-phase type.

Wagner single-phase motors are furnished for all frequencies from 25 to 140 cycles and in various sizes from one-quarter horsepower to forty horsepower capacity.

The Wagner variable-speed motor differs from the constant speed motor principally in that it has a commutator of the horizontal type, which remains in service all the time. As the torque of alternating motors varies directly as the squares of the applied pressure, wide speed variation may be obtained by varying the voltages applied at the motor terminals.

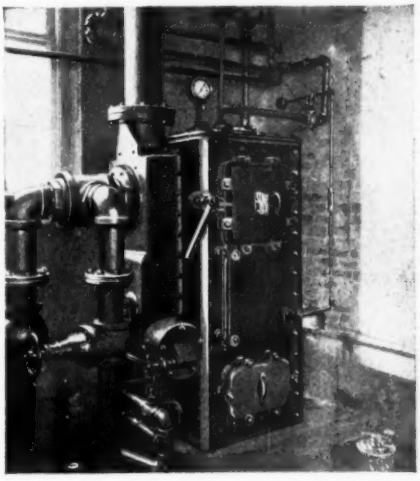
The motors above described are manufactured by the Wagner Manufacturing Company, of St. Louis, Mo.

Innovation in Open Feed Water Heaters.

THE practice of utilizing exhaust steam for heating or drying purposes is becoming general. If the piping system is properly designed for the flow of the larger volume of steam and for the avoidance of air or water binding, exhaust steam heating is in every respect as satisfactory as live steam heating, and offers a great economy in fuel, since a pound of exhaust steam contains just as much heat as a pound of live steam at the same temperature and in fact from 80 to 90 per cent as much available heat as was present in the steam before it passed through the engine cylinder. Where there is need for all of the available exhaust steam for heating or drying purposes, the cost of fuel for running the engine becomes, in fact, almost negligible.

In many of the early exhaust steam heating plants, it was attempted to utilize the existing live steam piping, which because of its small size and because of its arrangement, frequently placed a considerable back pressure upon the engine. It was also found that where the engine exhausted directly into the piping system, the latter in time became coated with cylinder oil and grease, so that the efficiency of the radiators gradually became considerably impaired. Because of this oil in the condensed steam and also because of the lack of suitable receiving tanks for collecting the condensed re-

turns, the latter were often permitted to run to waste, representing a loss, not only of the water, but also of an amount of heat required to raise an equivalent weight of cold feed water up to the temperature of the returns. Not only this, but the water thrown away, was, except for this content of oil, pure, distilled water containing no scale-forming matter, and unequalled for boiler feding purposes. The obvious waste in buying or pumping cold water to feed the boilers while hot water was being discharged to



the sewer led to the designing of various arrangements and appliances for purifying the exhaust steam of oil and for conserving the returns and reheating them before they were pumped to the boiler.

An arrangement still frequently installed consists of the following parts:

An oil separator in the exhaust main, followed by a closed feed water heater, preferably arranged with suitable valves and piping for by-passing when it is desired to cut out the heater for cleaning or repairs, and a receiver or hot well for the reception of the returns, generally fitted with an automatic controller for admitting sufficient raw water to make up for leakage and other losses. From this receiver the water is taken by the boiler feed pump and forced through the closed heater into the boiler. For the drainage of the oil separator a suitable trap must be installed. This aggregation of apparatus requires a good deal of room and a large number of valves, tees, elbows and other fittings, as well as a large labor bill for the proper installation.

A great simplification and improvement was gained by the introduction of the open heater. Here the heater takes the place, or performs the functions of heater, separator, trap, hot well, cold water regulator and feed water filter and skimming tank, but in order to protect the heating system from oil it is necessary either to pass all of the exhaust steam through the heater or else to install an independent separator with trap in the branch exhaust line to the heating system. The objections to the first method are found in the fact that in order to be able to purify all of the exhaust steam that may be delivered by the engines, an unnecessarily large heater, as regards the water heating capacity, must be installed in order to get a large enough separator to handle the steam, and even then it is not possible to cut the heater out for cleaning while the heating system is in operation. The drawbacks of the second method are found in the extra cost of the additional separator, valves and fittings, and of the labor required to install them. Not only this, but it is difficult, in the congested basements of modern office buildings, hotels, etc., to run large piping, say 12-inch, 16-inch, 20-inch, etc., around the corners or hugging the ceiling or wall or to double back with the piping, in order to convey the exhaust from the feed water heater to the heating system and to arrange for the connection through the back pressure valve to atmosphere.

In a new heater just introduced by the Harrison Safety Boiler Works, Philadelphia, Pa., all these difficulties have been neatly avoided, while certain new advantages have been gained. The new heater possesses all the features of the well-known Cochrane heater, that is,

it heats the water by direct, actual contact with the purified steam and provides for the retention of precipitated scale-forming matter on trays and in the filter, for the escape of air and gases and for the automatic admission of sufficient new water to make up the full amount of boiler feed.

The new feature consists of a specially designed separator which is large enough in volume to purify all the steam required for heating the boiler feed water and also to handle the entire amount of steam exhausted by the engines and pumps, so that the surplus can pass directly to the heating or drying system without further purification. Upon entering the separator the steam strikes a vertically ribbed baffle plate, such as is used in the oil separators attached to other Cochrane heaters, but after passing around the baffle plate, that part of the steam required for heating the feed supply is diverted into the heater proper while the surplus steam is passed to the heating system through the "steam stack" at the top of the separator. The arrangement of parts is such that the "preference" is into the heater, so that the feed water will be heated up to the maximum temperature before steam passes to the heating system.

Now, to provide for shutting the interior of the heater off from the steam piping, that is, to make it possible to open and clean the heater while the heating system continues in operation, a cut-out valve is placed in the opening between the heater and the separator, while a similar valve is placed between the overflow opening of the heater and the steam trap, even when the heater is cut out of service. The steam cut-out valve is of cylindrical semi-rotating type and is operated from the outside by means of a suitable lever.

This large separator with valves thus takes the place, it will be noted, not only of the separator on the ordinary open feed water heater, but of one or more gate valves and tees, and an independent separator with trap and connections. The comparison in the accompanying illustration shows the least number of extra valves, fittings, separators, traps, etc., required by an ordinary heater and receiver to perform the functions of the new surplus exhaust and cut-out valve heater. In many installations much more complicated arrangements have been installed to perform this service. For installations where there is no necessity of cutting the heater out of service while exhaust steam is being supplied to the heating system, as where a plant is running during only a part of the 24 hours, the cut-out valves can be omitted, although they are recommended even in such cases, particularly when the heater is used in connection with a heating or drying system.

Industrial Notes.

—Wm. B. Scaife & Sons Co., Pittsburgh, Pa., have received a contract from the Standard Steel Company of Cleveland, Ohio, for the structural steel work for several new buildings to be erected near Bedford, Ohio.

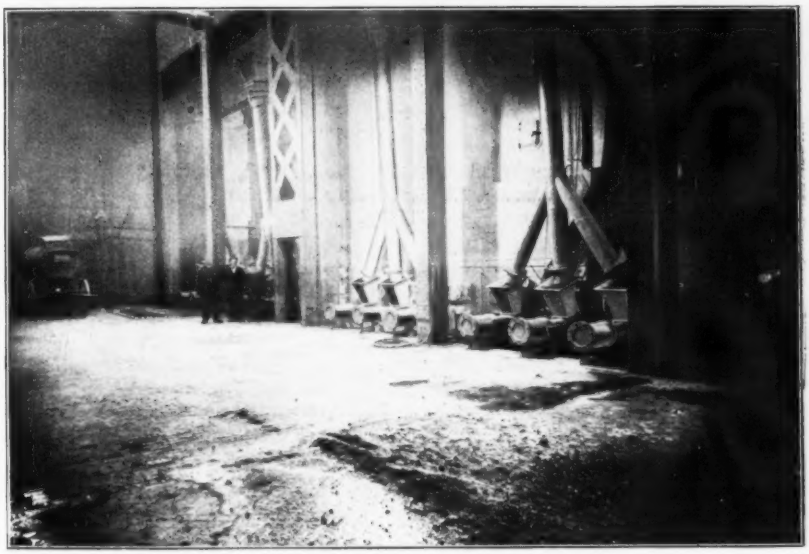
—The Turner Construction, Company, 11 Broadway, New York, have just been awarded a general contract for the construction of a reinforced concrete factory for the Barnet Leather Co., Little Falls, N. Y. This building will be 100' x 94', four stories high. Linn Kinne is the architect. Work will be commenced at once.

—A test of safety devices, safety cans, etc., was recently made at the test grounds of the New York City Fire Department by the Municipal Explosive Commission. The McNutt Non-Explosive Mfg. Co. responded to this invitation and gave an exhibition of eight different styled gasolene cans, also a number of gasolene storage tanks, plumbers' torches, lamps, etc., tanks and cans with automatic closures, single and double openings, fusable vents and safety valves. The results show that burning buildings in which volatile inflammable liquids are kept in containers of the McNutt non-explosive types will receive the minimum damage of ordinary lubricating oils, also safeguarding against spreading fire from defective containers. The McNutt Non-Explosive Mfg. Co., 148 West 27th St., New York, have issued a leaflet giving full details of the tests, which they will send on request to those interested in fire prevention.

THE CURRENT RECORD OF
IMPROVED MACHINERY
NEW METHODS NEW MATERIALS
NEW APPLIANCES

Remarkable Boiler Tests.

A TEST recently conducted at the plant of the Union Gas and Electric Co., Cincinnati, in the burning of Island Creek coal fired by Jones Underfeed stokers under Stirling boilers, shows results so remarkable that the full test and figures should be secured by power-plant managers and steam users interested in the possibilities of economical and efficient burning of coal in the boiler-room. In these tests, two of 10 hours duration and one of 5 hours, rates of combustion of 25.84, 33.26 and 44.69 pounds of coal, respectively, per square foot of grate per hour were obtained. The carbon-dioxide percentages by volume in the flue gas corresponding to these rates were 12.93, 13.66 and 14.88, the oxygen acompanying these figures being 7.28, 6.71 and 5.72, with no carbon monoxide present in any case. The evaporation obtained was 4.70, 5.89, and 7.82 pounds of water from and at 212 degrees per square foot of heating surface per hour, or 12.14, 11.69, and 11.55 pounds of water per pound of coal as fired. Allowing for the 1 per cent of moisture present, this equals 12.26, 11.81 and 11.67 pounds of water per pound of dry coal.



JONES UNDERFEED STOKER INSTALLATION.

Very great interest for steam users lies in these figures of evaporation, as

contrasted, for example, with the average of perhaps 8.5 pounds usual in ordinary practice; but no less remarkable is the high economy and the very perfect combustion obtained even under severe overload. In the second test the boiler was worked to 170 per cent and in the third to 226 per cent of the builder's rating. The coal burned in this last case was increased 73 per cent above the normal, and Mr. Groverman says "It is safe to infer that if necessary it could have been increased 100 per cent." The high percentage of carbon dioxide and the absence of carbon monoxide in the flue gases, even at this rate of combustion, is high testimony to the excellence of the firing obtained by the Jones stokers.

For convenience in examination some of the more important data are tabulated below:

Stoker	Jones underfeed		
Fuel	Island Creek coal		
Boiler	Stirling		
Grate area, square feet	81.25		
Square feet water-heating surface	5,420		
Ratio of water-heating surface to grate surface	66.7 to 1		
Ratio of draft area to grate surface	1 to 4.3		
Number of test	1	2	3
Average steam pressure, by gauge	155.6	155.4	158.0
Draft between boiler and damper, inches	0.5	0.6	1.1
Draft in ash pit, inches	1.6	1.98	3.3
Temperature of water entering boiler, degrees	120.6	119.8	121.7
Temperature of escaping gases, degrees	551.8	566.7	622.2
Coal as fired consumed per hour, pounds	2,100.2	2,730.0	3,668.0
Dry coal consumed per hour, pounds	2,079.2	2,702.7	3,631.3
Dry coal per square foot of grate surface per hour, pounds	25.84	33.26	44.69
Heating value of dry coal per pound, B.t.u.	14,273	14,149	14,212
Water evaporated per hour from and at 212 degrees, pounds	25,501.85	31,921.58	42,385.04
Equivalent evaporation per hour, per square foot of heating surface, pounds	4.70	5.89	7.82
Horse power developed	739.18	925.30	1,228.60
Builders' rated horse power	542.0	542.0	542.0
Percentage of rated horse power developed	136.36	170.70	226.70
Water evaporated from and at 212 degrees per pound of coal as fired	12.14	11.69	11.55
Efficiency of boilers and grates, per cent	82.98	80.60	79.28
Coal fired to develop one horse power, pounds	2.84	2.95	2.99
Coal fired to evaporate 1,000 pounds of water from and 212 degrees, pounds	82.35	85.52	86.54

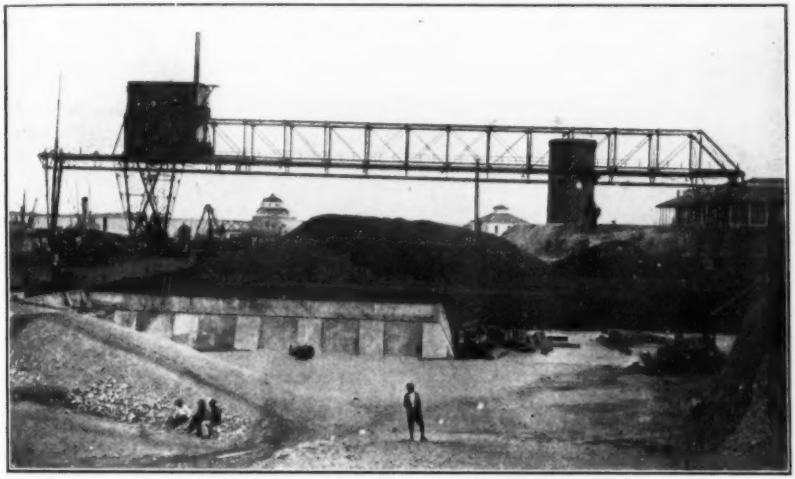
The test, which was conducted by Mr. W. H. Groverman, M.E., is accompanied by a very interesting discussion of the movement among steam users in favor of demand for a guaranteed B.t.u. value in coal purchased, and by the full description of the methods of testing and the results, in great detail. It is verified by John W. Hill & Sons, and may be obtained complete by application to the Underfeed Stoker Co. of America, Marquette Building, Chicago, Ill.

Naval Coaling Station in Cuba.

AT the termination of the Spanish-American war, the U. S. Naval Bureau acquired certain territory bordering on the Guantanamo Bay, dredged a channel for water approach, built a wharf having a frontage of 340 feet, and a coal storage area of 68,000 square feet in the rear. Owing to the urgent need of this station a temporary coal handling and storing equipment was installed. This has been replaced by a modern handling installation furnished

by the C. W. Hunt Co., West New Brighton, N. Y.

The operating machinery is mounted on a structural steel frame or bridge spanning the storage area, with a distance center to center of tracks of 261 feet. This bridge is supported by structural steel legs, each mounted on a universal truck. Each truck has the necessary number of wheels for the moving of the tower lengthwise over the storage area. The tower is moved by means of electric motors, geared to the driving wheels of the truck, one motor for each track. These motors are controlled by one controller stationed in the operating room of the tower. The coal handling machinery, however, is operated by steam power.



COALING STATION AT GUANTANAMO, CUBA.

The operating machinery is housed at a central point and so arranged as to require two operators, one operator to control the lowering of the two and a half ton grab bucket, the filling of the bucket and the raising of the bucket: the other operator to control the running in and out of the trolley truck over the boom and the discharging of the bucket over the storage area.

The engines are all of the Hunt heavy duty type, massive in construction, and especially designed for heavy continuous duty, ensuring durability of service, economy of steam and low maintenance cost.

The grab bucket or shovel is of especial construction, in that it is symmetrical as regards its center of gravity, thus avoiding the usual chafing and wear on the operating room; the reach of the scoops is adjustable, so that the bucket will operate with equal facility on various grades of coal; the bucket has exceptionally great closing power, stiffness and strength.

At the official trial the plant developed a capacity of 100 per cent. over and above that guaranteed by the contractors.

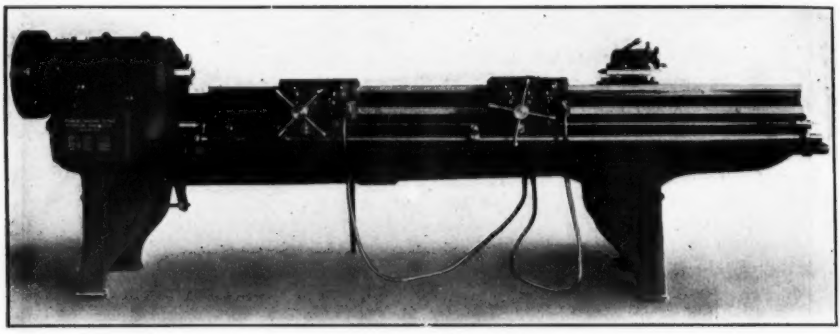
The "Lo-swing" Lathe.

THE Fitchburg Machine Works of Fitchburg, Mass., manufacture a lathe, which they call the "Lo-swing" lathe, because it is particularly adapted for turning parts which do not exceed 3½ inches in diameter. This lathe was brought out to fill the demand for a machine for producing such parts as axles, steering knuckles, transmissions and cam shafts more economically than is possible with an ordinary lathe. By limiting the swing the usual lathe cross slide is eliminated and in and out adjustment of tool obtained by a screw with micrometer ring which bears against

the end of the tool, lying in a heavy block holder. This construction reduces vibration at the cutting point and permits of a higher peripheral speed and greater depths of cut. A roller type of rest in place of the usual crotch rest is employed.

These machines are fitted with two 15-inch carriages which are designed so as to pass the tailstock. Six tool holders are regularly supplied and can be attached at any position on carriages, the idea being to finish a piece having several diameters, either straight or tapering, at one travel of the carriage at each end of the work instead of, as is customary, machining one diameter the required distance and drawing the carriage back and then adjusting the tool to turn another diameter, and so on. A compensating stop mechanism to take care of varying lengths and depths of center holes is also provided, so that after this lathe is set up to handle a job, at certain predetermined speeds and feeds, no time is lost by the operator in measuring lengths or in calipering the work.

On request the builders will furnish fully illustrated descriptions of its advantages in the work for which the "Lo-swing" lathe is designed.



THE "LO-SWING" LATHE.

Electric Hoist for Handling Pier Cars.

THE Sewall's Point coal shipping terminal of the newly opened Virginia Railway, is operated in a novel manner and contains some interesting machinery, including a 1,000 H. P. electric hoist designed and built by the Lidgerwood Mfg. Company of New York. The pier has a capacity of 30 cars per hour—15,000 tons in 10 hours, or 4,500,000 tons per year of 300 working days. Eventually the plan calls for four such piers giving a capacity of 18,000,000 tons a year. The design of the pier and equipment was adopted so as to enable the company to bring coal from the West Virginia mines to sea board in gondola cars which could be utilized for taking other freight westward. As the road expects to have fully 5,000 cars in service, this was considered particularly desirable. The coal pier is 1,865 feet long from the shore line to the main harbor channels. It is of steel, resting on concrete foundations. The process of getting the coal from the cars into the hoppers from which vessels are loaded comprises two operations. In the first of these the cars are allowed to drift down by gravity, one by one, to where a barney car can pick them up and carry them up a short incline to a dumper. The dumper picks each car up bodily, tips it to an angle of 65 degrees so that the coal is poured out into a special conveyor car of larger capacity, to be taken to the hoppers on the pier. There are ten of these special conveyor cars.. They are of steel with hopper bottoms and each carries a load of 100,000 pounds of coal. As soon as each

conveyor car is loaded it is taken in hand by the high hoist which, by means of a barney car, draws it up a 25 per cent incline at a speed of 480 feet per minute. The incline is 400 feet long. It takes 45 seconds for the car to reach the knuckle. Once upon the higher level and past the knuckle of the incline, the conveyor car proceeds down the pier under its own power, as each is equipped with electric motors taking power from an overhead trolley and controlled from a cab at one end. The big hoist returns the barney car to the foot of the incline, ready for another trip, at a speed of 555 feet per minute. The round trip is made in 1 minute and 20 seconds. The conveyor car goes to hoppers along the pier and deposits its load wherever it is wanted. The hopper bottoms of the cars are operated by compressed air, supplied by automatic electric compressors on the cars. Having deposited its load, the conveyor car returns by a kickback system, which allows it to drift back down a gentle incline to the bottom of the slope to be refilled.

The Lidgerwood hoist which hauls the conveyor cars up the incline is an interesting part of the equipment. Each conveyor car with its load weighs nearly 200,000 lbs. The hoist complete, with its two motors, weighs 180,000 lbs. But one motor is used at a time, the other being provided to insure constant operation. The motors are of the General Electric Company's make of the M.P.C. class. They are rated at 500 horse power, and actually develop 980 horse power each. The drum of the hoist is 84 inches in diameter, with a face of 42½ inches in width, grooved for a 1¾ inch main cable and having also a section with a 7-inch face grooved for a ¾-inch tail rope for insuring the return of the barney car. The flanges are 6 inches in depth. The main gear wheel is 116 inches in diameter. The pinion which drives this is 19 inches in diameter. The intermediate gear wheel is 72 inches in diameter, with a 21-inch pinion. All the gears are of cast steel with machine cut teeth. The drum has powerful post brakes. These are controlled by a solenoid through the medium of compressed air. The compressed air is supplied at a pressure of 80 lbs. to the inch by an electric compressor which forms part of the hoist outfit. The general operation of the hoist is controlled by an operator near the barney car pit, 350 feet distant from the hoist, but the hoist is provided with an emergency limit switch which makes certain that it cannot overwind in either direction. The brake is set by a weight of 1,400 pounds actuating a suitable lever. When the current is turned on the solenoid drop acts and by means of the compressed air releases the brake. Then the current is cut off, whether by intention or accident, the solenoid drops, releases the air, and the weight brings the brake into action, holding the load safely in any position.

High Pressure Gas Transmission.

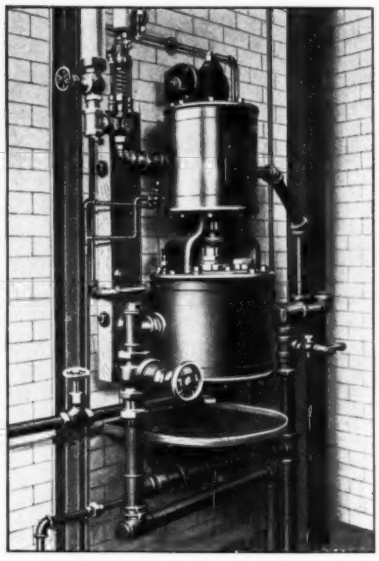
DURING the past few years the apparatus for manufacturing and purifying gas has been greatly improved, and the many by-products obtained have found a wide demand. To prepare these by-products economically in marketable shape requires a plant of comparatively large production, so that the tendency now is to centralize the point of manufacture for several neighboring communities, thus obtaining the benefits resulting from the disposal of the by-products.

This idea of a central plant supplying a considerable area, naturally implies the necessity of many miles of piping, which, applied to the ordinary low-pressure system with its large, heavy pipes, means a large outlay of capital. But with the high-pressure system of gas transmission, these disadvantages are avoided and many additional advantages obtained.

The installation of a compressor to accomplish this stepping up of the pressure from that at which the gas is produced to that at which it is transmitted, involves no complication of apparatus and no considerable outlay of capital. A large compressor is seldom necessary; and, with a suitable governing device, no special attention is re-

quired to insure perfectly reliable operation.

The standard types of air compressors used in steam and electric railroad service, and manufactured by the Westinghouse Air Brake Company, are particularly well adapted for compressing gas for transmission at high pressure. Their distinguishing characteristics are



WESTINGHOUSE GAS COMPRESSOR.

simplicity, ease of installation, reliability, durability and low cost of maintenance.

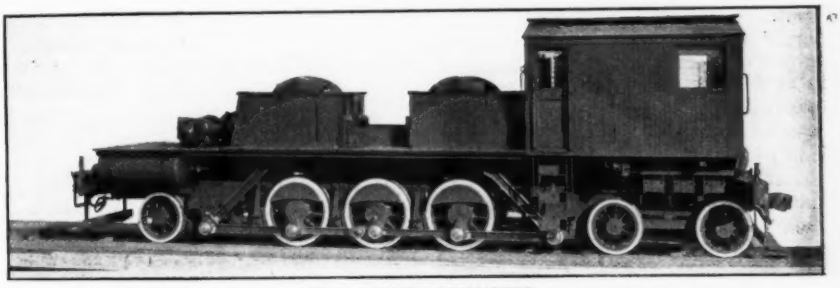
They may be driven either by steam or an electric motor. One type of such compressor is illustrated in the accompanying cut. It occupies but small space and is simple in general arrangement. It is connected so as to draw the low-pressure gas directly from the gasometer, compress it and deliver it through a suitable storage reservoir into the high-pressure mains. For cases where the high-pressure is required to be constant during the twenty-four hours, an automatic governor may be applied to the compressor, which regulates its speed so as to maintain the desired pressure practically constant. For cases where the high-pressure is raised to a certain maximum and allowed to decrease to a fixed minimum, a governor may be furnished which will stop and start the compressor for any desired range of pressures.

The following application illustrates the simplicity of this system. An eastern municipal gas and electric light plant supplies three neighboring towns. It is situated in the central part of one town and is from three to four miles from the others. The whole town where the plant is situated is supplied with low-pressure gas, flowing directly from the gasometer through large mains at a pressure of 2½ inches of water. The other towns are supplied through high-pressure mains, the gas being drawn from the gasometer by the compressor and delivered directly into the high-pressure mains. A governing valve is placed in each house supplied by these high-pressure mains, which automatically reduces the pressure to the low house-service pressure. About fifteen miles of two-inch pipe are already laid in the territory of about four miles' radius covered by the high-pressure system.

The gas compressing outfit in this plant consists of two Westinghouse 9½-inch by 13-inch by 10-inch water-jacketed compressors mounted on the wall of the engine room. The steam pressure varies from 60 to 100 pounds at different periods of the day. Only one compressor is used at a time, the other being a spare unit. The low gas pressure is very constant. The high pressure varies from 10 to 14 pounds, being lowest in the day time when the steam pressure is low. The average number of cubic feet of gas delivered during the day time appears to be from 10 to 12 cubic feet per minute, running up to about 25 cubic feet in the late afternoon, at the time when gas is required for both lighting and cooking.

The management of the gas works express themselves as perfectly satisfied with the compressor operation. The operating unit is shut down only occa-

sionally, about once or twice a month, during the hours of the day when the gas consumption is lightest, to clean and oil the valves; and the storage in the mains is then enough to supply the demand until the plant can be started again. At all other times no attention whatever is paid to the compressor, outside of oiling.



NOVEL ELECTRIC LOCOMOTIVE.

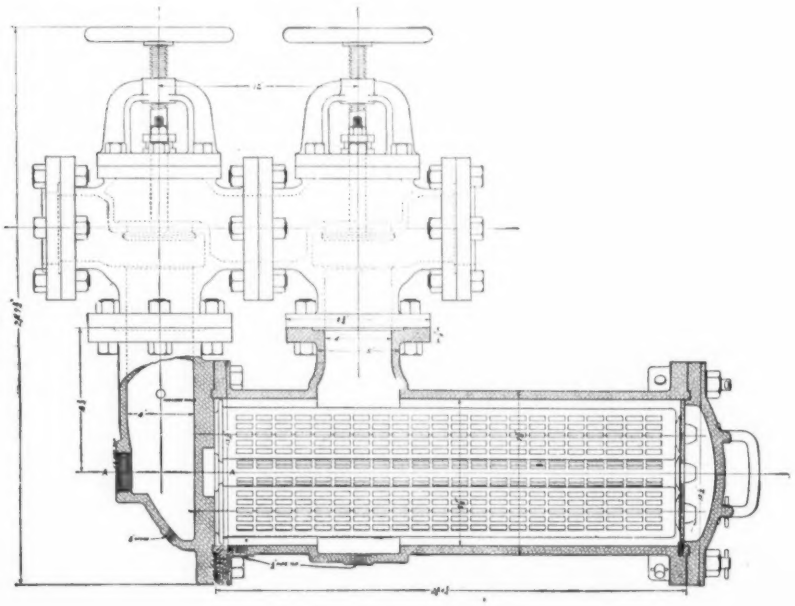
A Novel Electric Locomotive.

THE accompanying photograph illustrates a novel type of electric locomotive which has been designed jointly by the General Electric and American Locomotive Companies for trying out a scheme of transmitting power from the motors to the drivers through siderods instead of by the ordinary methods. The locomotive is designed for a tractive effort of 30,000 lbs. at a speed of 18 miles per hour, with a maximum speed of 50 miles per hour, and will operate equally well in either direction. It has been tried out with temporary motors of a somewhat smaller capacity and the tests have demonstrated conclusively that the design is entirely satisfactory in every way. It is proposed to extend the cab over the entire length of the machine when the proper motors are installed on the locomotive. The present cab and guards are only for the temporary protection of the apparatus now installed. One of the principal advantages found in this type of construction is that a motor of large diameter and small air gap can be used in conjunction with small diameter driving wheels, and at the same time the motor can be spring supported. The motor bearings can be very easily designed to maintain the small air gap. Such a form of construction will also secure a marked economy in the construction of the motors, as the same horsepower can be obtained in two motors at a less cost and for less weight than in four smaller motors. The same motor equipment can also be used on locomotives with different diameters of driving wheels. This feature makes possible the interchange of equipment on roads where both freight and passenger locomotives of this type are employed. This type of locomotive is as well adapted for operation with direct current motors as with those of the alternating current type.

The motors in such a locomotive can be located so as to concentrate a greater proportion of the weight near the center of the machine, with the attendant advantage that the moment of inertia of the locomotive around its vertical axis will be as small as possible. This will reduce the rail pressures at the leading and trailing wheels and consequently the flange and rail-head wear. The location of the motors in the cab facilitates inspection and repairs and the renewal of brushes. The maintenance charges for the motors will also be greatly reduced as practically all road dust and other foreign material can be kept out. The electrical control is arranged in such a manner that the motors start as repulsion motors with short circuited armatures and are changed over to series repulsion motors for the higher

speeds. This arrangement eliminates running with a short circuited armature on high voltage and at the same time gives a high torque at starting. In fact the tractive effort is about twice as great with repulsion motor connections as with series repulsion connections for a corresponding current value. The armatures are similar to those of an ordinary direct current machine with equalizer rings. They have multiple drum windings with the bars soldered directly into the commutator segments. The field or stationary windings are of the distributed type and are made in two sections: the exciting and the inducing windings. The former has the same function as the field winding in an ordinary series motor, while the inducing winding introduces the working torque when the motor is connected as a repulsion motor. All parts of the running gear such as wheels, driving boxes, axles, springs, spring rigging, trucks, etc., follow standard steam locomotive practice.

The arrangement of the siderods is shown in the illustration and it will be noticed that each motor is coupled to a jack shaft and thence to the drivers. The jack shaft bearings are rigid in the spring supported locomotive frame and their centers are on a level with those of the drivers. The object of this jack shaft is to permit a horizontal drive between the spring supported part of the locomotive and the driving wheels and is necessary in order to allow a vertical play of the spring supported part with a negligible variation in the distance between the crank centers. Counterweights are used on the driving wheels to balance the siderods and it should be noticed that there are no reciprocating parts and therefore a perfect balance can be obtained.



FEED WATER GREASE EXTRACTOR.

New Feed-Water Grease Extractor.

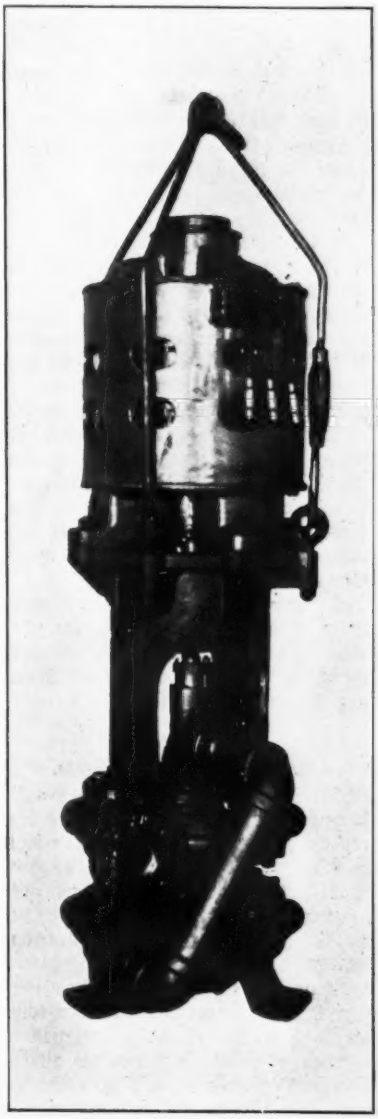
THE illustration opposite shows a new type of feed-water grease extractor made by the American Steam Gauge & Valve Mfg. Co., Boston, Mass. Two valves forming the inlet and discharge from the extractor when seated as shown in print force the water into the shell of the extractor through the cartridges and, in this manner, the grease is extracted. Where the valves are seated on the lower seat, they form a bye-pass so that the shell of the extractor can be opened, the cartridges taken out and either replaced with an extra set or cleaned and put back. The cover on the cartridges and form of applying is plainly shown in the print. They are held firmly in place by seating the base and by plate and spring washers at the top. The ratio of the openings in the cartridges to the inlet of the extractor is 48 to 1.

The pressure gauges are applied to both the main chamber and base so as to note the difference in pressure and tell when the pressure in the main casing is increased by the restricted flow of the water due to the covering of the cartridges becoming filled with grease. Provision is also made in the base to connect ¼-inch steam pipe, driving steam into the inside of the cartridges and in this manner cleaning them, so as not to necessitate taking the cartridges out as often as would otherwise be necessary.

The shell of the extractor is small and compact as compared with some of the cartridges on the market. The shape of the cartridges is triangular, enabling their placing in a comparatively smaller space. Two of the strong features are that it is much smaller and lighter than other extractors. This is a decided feature, especially aboard ship. This device is intended for stationary or marine practice. Another decided feature is the fact that it can be placed in any position. This makes it possible to use it in places where other similar devices, which must be placed upright or in some certain position, cannot be used. This can be connected, as shown in the print, direct to operating valves or to the valves in the pipe line.

Unusual Centrifugal Pump.

THE accompanying illustration shows a 2½" compound vertical shaft sinking pump driven by a 20 H. P. motor designed to handle from 120 to 180 G. P. M. against varying



AN UNUSUAL CENTRIFUGAL PUMP.

heads up to 225 ft. The pump is equipped with bronze runners, each made in two pieces to facilitate furnishing the interior waterways exactly to template, brass glands, forged steel shaft and cast iron casings and side plates. Also, the action of the thrust is balanced for the pump; the suction inlet is at the bottom of the lower or first stage, while the inlet for the second stage from the first is above at the top of the upper casing. The thrust bearing on the motor was built sufficiently heavy to bear the weight not only of the motor rotor, but also of the moving parts of the pump, the shafts being connected only by flange coupling, each half being held securely to the shaft by taper pin.

When in place in the mine shaft the motor is protected from dropping stones by a circular conical baffle or deflector made of ¼-inch boiler plate and slung below the ring on the three rods supporting the pump from the tackle. A similar plate is attached to the bottom of the machine to guide it down the shaft to prevent catching on cross timbers. Water is taken through about ten feet of wound heavy rubber hose connecting with the suction inlet, and protected at the lower end by an ample strainer.

The pump construction as shown weighs without motor 650 lbs., and with motor 1,500 lbs., and was recently shipped abroad by the Buffalo Steam Pump Company of Buffalo, N. Y.

4,000-Ton Hydraulic Press.

ALMOST every large hydraulic press embodies some peculiar features or operates under unusual conditions. The Watson-Stillman press shown in the illustration is interesting, not only on account of its large size, but also because it was built under specifications which stipulated that the moving platen should not spring more than 0.01 inch under the maximum load of 4,000 tons. The machine was specially designed to compress a plastic material to almost uniform thickness within a mold of which the upper and moving platen form the top and bottom faces respectively. The sides of this mould consist of a practically solid steel band 7 inches high and 5 inches thick, which rests on the moving platen while the material is under pressure. Absolutely uniform dimensions and great density of finished product are two essential requirements of the press. The extent to which these are secured may be inferred from the fact that the top of the mould clears the sides by about 1-64 of an inch

A 4,000-TON HYDRAULIC PRESS.

and that 8,000,000 pounds pressure can be equally distributed over the mould, about 25 square feet in area and about 9 feet across the diagonal. To obtain this enormous pressure upon the material in the mould an operating pressure of 5,800 pounds per square inch is required upon the main ram, which is 42 inches in diameter. With the exception of the ram, which is of chilled iron, all parts under stress are of steel. The three platens are steel castings, and the columns are turned from a high grade of machinery steel. The cylinder is cast from nickel-steel, which, as is well known, is far superior to ordinary carbon steel in strength and toughness, and permits of the lightest weight of metal to perform safely a given duty. This steel construction keeps the total weight of the machine to the comparatively low limit of 115 tons and also makes a press of much smaller dimensions than any cast-iron machine of equal power.

The stroke of the ram is 18 inches, but the actual work of compression is accomplished through less than one-tenth of that distance. A hydraulic accumulator is used to speed the ram up to load and the operating pressure is then taken direct from the hydraulic pumps. After the material has been compressed, the mould is stripped by raising the sides. This is accomplished by simultaneously turning the operating pressure into the four 6-inch stripping cylinders, whose piston rods pass up through the moving platen and rest near the corners of the flask. Any inequality of pressure from the cylinders or tendency of the flask to stick in spots is prevented by racks and pinions, effecting the even raising or lowering of the flask. The two corners of the flask on each end are made to move uniformly by the intermeshing of the pinions at the centre, while the corresponding movement of one end with reference to the other is assured by mounting the two pinions of the same side upon the same shaft. It is thus evident that force exerted on one corner would be equally distributed to raise the whole flask. This prevents strain and bad alignment. The stripping cylinder rams have a travel of 23¼ inches, so that they will bring the flask down into position on the moving platen when the main ram is at the extreme bottom of its stroke.

A New Sand Blast.

THE accompanying illustration shows a new sand blast, embracing a number of original features. It will be observed that the hopper is mounted on four structural steel legs, making the

NOVEL SAND BLAST.

blast easily portable. This machine will clean brass, aluminum, iron and steel castings, brick and stone work, remove paint and rust.

The hopper is an open one, being supplied with an automatic screen, which permits the sand, with one shoveling, to be taken from the floor or pile screened and the gravel, foreign matter, etc., automatically rejected, only the desired particles passing into the hopper. An air jet automatically removes the dust from the sand which passes into the hopper.

The sand cannot absorb moisture from the compressed air, as the sand does not come in contact with the air until the moment of leaving the nozzle; hence neither gun nor hose can become clogged. Either high or low air pressure can be used. High air pressure is

recommended, as it gives to the sand the greatest possible velocity and maximum cutting power with the least amount of air.

Both the air and sand are controlled by the operator at the gun, so that just as soon as the operator shuts off the air supply the sand ceases to flow and the hose cannot become filled with sand. The sand is drawn slowly through the hose by means of suction, obviating the necessity of a high-priced sand hose. This blast will do work that a low pressure blast will not do. The manufacturers, Curtis and Company Manufacturing Company, St. Louis, Mo., will be glad to supply attractive literature and give further information regarding this tool.

Feed Water Heaters.

PROTECTION against oil getting into the boilers is a prime factor of ultimate power plant economy and safety wherever heat from the exhaust steam is utilized for preheating the feed water. If oil-laden exhaust comes into direct contact with the supply water the latter is bound to be more or less contaminated by the oil particles, which, if not removed, collect on and ruin the boiler heating surfaces. The seriousness of this may be inferred from the fact that in many large plants running condensing, as in some of those of The New York Edison Company, the water of condensation and its contained heat are thrown away just to avoid letting the oil from this condensation get to the boilers.

This fear of oil has influenced many an engineer to equip his plant with a closed rather than open heater, regardless of price difference. In the former, the exhaust steam cannot mingle with the feed water, and hence there is no danger of contaminating the water supply with impurities from the steam. The brass tubes of a closed heater, if kept clean, offer practically no resistance to the transfer of heat. Even if they did, there would be no loss of efficiency in the closed heater that would make a detrimental comparison with the performance of an open heater, for in any heater only a small part of the exhaust

FEED WATER HEATER.

steam is required to heat all the feed water from supply temperature to about that of the exhaust.

It is a fair assumption that protection from oil is as important a requirement as is the heating efficiency. These re-

quirements are well met in the new Goubert "Multipass" heater, and made in sizes of from 50 to 5,000 H. P. by the Goubert Manufacturing Company of New York. This apparatus is guaranteed by the manufacturers to heat feed water from ordinary temperature to within 10 degrees of the temperature of the exhaust steam. Referring to the illustration, the Goubert heater consists essentially of two cast iron water chambers connected together by a cluster of small straight brass tubes, which in turn are enclosed within a cylindrical cast iron shell extending from one water chamber to the other. The ends of the tubes are rolled into steel tube plates in the same manner as boiler tubes are rolled into the manifold. The cast iron shell surrounding the tubes merely provides an envelope for the exhaust steam, and is of larger diameter than the water chambers, to form an annular belt from which the steam may enter among the tubes from all directions. The exhaust steam enters the shell by the upper opening shown at the right, and what does not condense passes out the lower opening. That which is condensed on the tubes flows to the bottom of the shell and passes out through a drip pipe. It is a peculiarity of this construction that oil or grease in the steam is removed as in an oil separator and passes off with the drip, leaving the remainder of the exhaust steam in the best possible condition for heating systems and other purposes where live steam is sometimes used.

In some closed heaters, the steam is made to circulate inside the tubes, while the water is in the shell. In either case the water is forced by the pump through the apparatus as though it were but a part of the feed pipe. In the steam tube type, however, the mud and sediment tend to settle at the bottom among the tubes where it is difficult to remove, while scale that may form on the tubes is also difficult to get at. One great advantage of having the water within the tubes, as in the Goubert heater, is that the scale may be removed without taking down the heater. It is obvious that by removing the top chamber the tube interiors can be examined and cleaned out with little difficulty. Any sediment which falls, either during cleaning or operation, goes down into the bottom of the lower water chamber from which it may be drawn out through the bottom blow-off openings. But the greatest advantage of the water tube construction is that which gives the Goubert heater its name "Multipass." As will be noted, there are baffles so placed in upper and lower chambers that the feed water entering at the bottom must travel back and forth through several sets of tubes, and be subjected to the heat of the steam several times before it can reach the outlet at the top. In a 700 H. P. Goubert Multipass heater, for instance (handling 21,000 gallons of water per hour), there are 100 tubes each one inch in diameter and over seven feet long. The feed water must travel five times the length of these tubes in the path of the steam, which gives every opportunity for absorbing the largest practicable amount of heat.

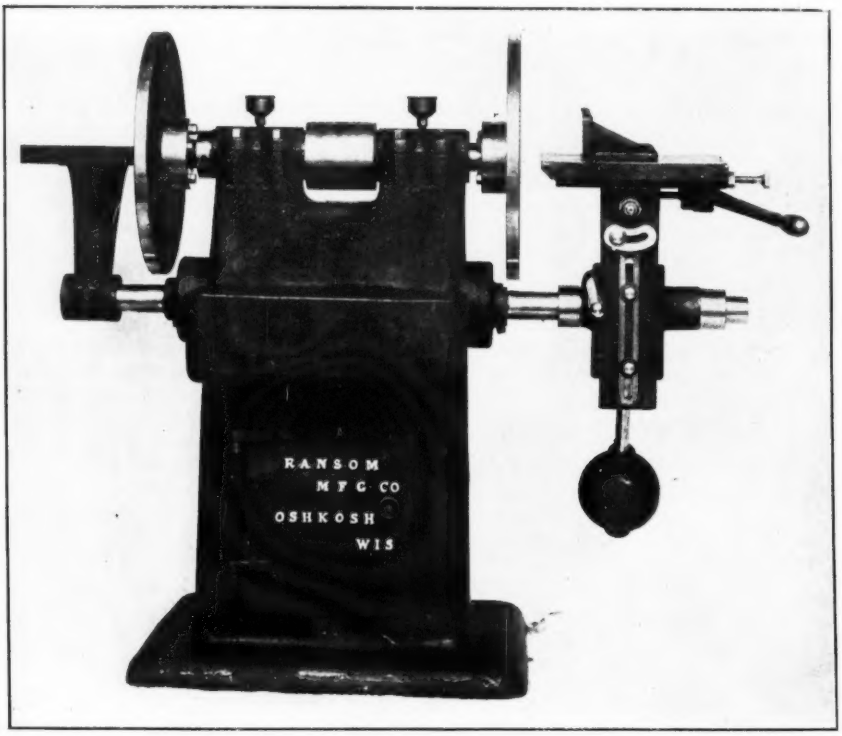
The differential expansion of parts of a feed water heater is with some constructions a matter which gives much trouble. It is evident that the shell and brass tubes will expand to different lengths under the possible difference of about a hundred and fifty degrees in temperature, and if no provision were made to compensate for this expansion, or in other words, if the connection between the shell and upper and lower water chambers was rigid, the tubes would start from their fastenings, leak, and render the apparatus useless. For this reason the Goubert heater is provided with an expansion joint between the upper chamber and the shell. The upper chamber is supported entirely by the tubes and left free to move up and down. The expansion joint is fitted with a flexible ring gasket composed of layers of soft copper and special packing with wire interwoven. The inner edge is clamped between the shell and a

ring. The only purpose of this gasket is to prevent steam from escaping into the room, and as it is subjected to no other pressure than atmospheric, the gasket will last for years. Its renewal amounts to nothing more than the replacing of a cylinder head or steam pipe gasket.

The vertical construction as described is preferable, but for installations where there is not sufficient head room, as in the cellars of city buildings, the horizontal heater can be used. This has the same essential features as the vertical type, and is also useful in connection with condensing engines. If it is desired to suspend the horizontal heater from the ceiling, the feet may be replaced by straps, lugs or bolts.

Ransom Disc Grinder.

THE spindle of this new disc grinder is made of high carbon steel turned and ground and runs in bearings lined with babbitt. The discs are made of steel turned true to within .001 of an inch, and are bolted to collars on the arbor with bolts and nuts instead of bevel head screws. The end thrust collars have nine square inches of surface. The shaft upon which the tables are supported is arranged so that it can be lined up parallel to the arbor. The table on the left end is 6x18 inches and is square to the face of the disc. The table on the right end is arranged to oscillate on the arm and can be raised or lowered. This table is 7x12 inches, is provided with



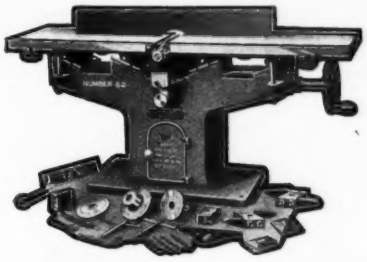
RANSOM DISC GRINDER.

two tee slots, and can be tilted to any angle necessary to the face of the disc. This table has lever feed with adjustable screw stop. All wearing surfaces exposed to emery are dust proof. Regular equipment includes the angle iron on right hand table, but special fixtures can be furnished for special work. The base of the machine is arranged to hold wrenches and tools; and the clamp is so arranged that the top can be swung out of the way to give free access to the disc.

The countershaft has self-oiling hangers and ground shaft. The loose pulley has an improved self-oiling bushing fastened to the shaft and drilled full of holes to hold a supply of oil. This insures the oiling of the loose pulley while the machine is standing still. Metal discs are not provided with grooves unless specially ordered, in which case this work is done free of charge. Better results will be obtained without the grooves. This machine is built by the Ransome Manufacturing Company, Oshkosh, Wis.

A Universal Woodworker.

THE machine shown herewith is manufactured by J. A. Fay & Egan Company, 212-232 West Front street, Cincinnati, Ohio. So great is the variety of work done on this machine that it is entitled the "Universal." It will do a variety of work that usually



UNIVERSAL WOOD-WORKER.

requires several different machines. It will plane out of wind, surface straight or tapering, rabbet door frames, rabbet and face inside blinds, joint, bevel, gain, chamfer, plow, make glue joints, square up bed posts, table legs, newels, raise panels, either square, bevel or ogee, stick beads, work circular mouldings, etc., rip, cross-cut, tenon, bore, route, rabbet, joint and bead window blinds, work edge mouldings, etc. The manufacturers have just issued a circular showing two large photographs and containing full description of their No. 62 Universal woodworker, together with a number of illustrations of the work done on this machine, which they will be pleased to send upon request.

Revolving Portable Elevator.

THE accompanying illustration shows a portable elevator and tiering machine made by the New York Revolving Portable Elevator Company, Jersey City, N. J. The wide application of such a device is immediately obvious, and besides its advantages in the saving

REVOLVING PORTABLE ELEVATOR.

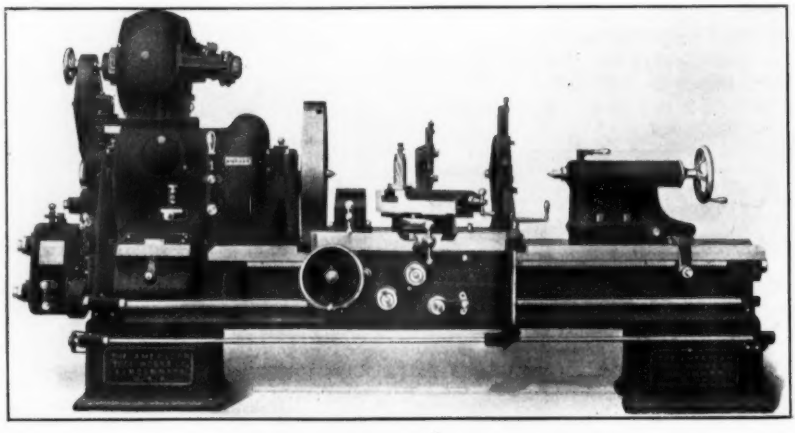
of labor and storage space it has proven a great advantage in repairing and erecting shafting, hangers and pulleys. The base is of malleable iron, in two

sections. The wheels are fitted to the bottom base and the upper structure to the top base, and between the two is fitted a ball-bearing race. The ball-bearing base is a distinguishing feature of this elevator. The revolving base makes it possible to load from either direction in narrow aisles and also unload at any point of the compass. The circle described by the extreme point in making a complete revolution is 4 feet 2 inches in diameter. The wheel base consists of only three wheels, and it will stand, therefore, solid on the roughest floors, whereas, if there were four points of contact with the floor, only three would touch at a time, except on perfectly smooth floors, because it is impossible to use a fifth wheel and turn as short as desired, owing to other important features. The gears are all cut from steel blanks, except the largest one, which is cut from a gray iron blank. The platform is 30 inches long by 24 inches wide, fitted with reversible rollers, so that it can be loaded from front or side, as desired. If it were not possible to revolve the base, all cases would have to be unloaded in the same direction as loaded, else the rollers in the platform would be of no use. Practice has demonstrated that it is very hard to load or unload heavy cases without rollers; therefore, in order to use the rollers in both cases the revolving base is necessary. The brake is made of a flat steel spring wound around two drums, and by a very small pressure of the hand on the brake lever a full-capacity load can be lowered at any speed desired, or stopped and held at any point. The ratchet, which is designed to catch the load at all points, is so constructed that the operator is compelled to remove the crank from the shaft and place it on the pawl shaft in order to lower the platform, thereby eliminating all possibility of the crank hitting the operator when lowering the platform. The floor space occupied is no more than required for an ordinary hand truck.

"American" Motor Driven Lathes.

THE accompanying illustration shows a type of lathe made by the American Tool Works Co., Cincinnati, Ohio, in 20, 24, 27, 30 and 36-inch sizes, and in any even length of bed desired.

The method of electric motor application is most satisfactory. To secure the proper spindle speeds for an electrically



"AMERICAN" MOTOR-DRIVEN LATHE.

driven lathe, the most practical and economical method is to supplement fundamental mechanical speed changes, through convenient levers, with electrical speed changes, advancing or receding by small increments at the will of the operator, through a motor controller handle conveniently located.

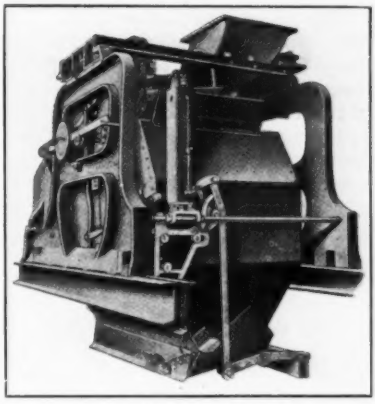
This lathe is equipped with geared headstock, which gives four mechanical speed changes with only six gears, by the manipulation of two levers at the front, as shown. An electric motor of any type (preferably one having a 2 to 1 speed variation) is mounted on the top of the headstock and connected to the main driving shaft of same through spur gears. The mechanical speed changes in the headstock, being supplemented by the electrical changes obtained through the motor, thus afford a very wide range of spindle speeds covering all usual requirements. The number of spindle speeds obtainable in either direction (forward or reverse) is four times the number of "working" contacts on the electrical controller, in that particular direction.

The controller handle is placed on right end of carriage, where it is always convenient to the hand of the operator for starting, stopping, reversing or varying the motor speeds. The controller is mounted on rear of cabinet leg, at headstock end of lathe. A speed index plate shows the maximum and minimum spindle speeds for each of the four mechanical speeds in the headstock, in connection with the motor speeds, and indicates the positions of the two levers on the headstock for each mechanical speed change.

The power of the motor depends upon the nature of work to be handled. An illustrated description, with full details will be sent on request by the builders.

Richardson Automatic Coal Scale.

THE weighing mechanism of the Richardson automatic scale consists of an equal armed beam, a weigh hopper with discharge controlling levers, a weight box, feed chute and feed controlling gate. The equal armed beam, which is of malleable iron, has hardened steel knife edges which are supported on bearings on two cast iron side frames, and supports, at equal distances from the fulcrum or main bearing, the cast



AUTOMATIC COAL SCALE.

iron weight box and the sheet steel hopper for the coal. These two receptacles, when empty, balance each other. Standard U. S. test weights for the required quantity of coal to be weighed, up to the capacity of the scale, are placed in the weight box and when the exact quantity of coal has been fed into the weighing hopper the feed gate of the scale automatically closes, the beam balances and the correct quantity of coal is discharged from the hopper. It should be noted that on the completion of every weighing this equal armed beam comes to a perfect balance, which can be seen without any manipulation of levers. This is a valuable feature, as it enables the observer to see at a glance that the weighings are accurate, thus avoiding the necessity of catching the discharge from the hopper and weighing it on a platform or other hand weighing machine to test the weighings.

The distinctly new feature of this machine is found in the feed chute and feed controlling gate, as shown in the illustration. Heretofore automatic scales have been equipped with an ordinary

under-cut gate which has been required to cut off a vertical head of coal. Such a gate has not proved generally satisfactory because of the difficulty of cutting off a big head of coal and the difficulty of opening such feed gate, when once it is closed, owing to the large quantity of coal carried upon it. Another familiar trouble has been the propensity for a lump of coal to wedge between the feed chute usually employed and this under-cut gate, thus preventing its proper operation. In the past the automatic scale, owing to the type of feed chute and gate used, has been unable to pass large lumps of coal, as these would choke in the chute and the scale would not operate until they were removed. With the new type of feed chute and gate, used in the improved Richardson scale, these difficulties are things of the past. The cast iron feed chute has an angle of about 40 degrees and is of such a construction that it is impossible for coal to bridge in it. The opening of this chute is of such size that it will pass, without blocking, practically any size of coal, and machines of suitable size, equipped with this chute, are in operation handling run-of-mine coal. This chute feeds the coal into the side of a drum gate, thus there is no vertical feed to or head of coal above the gate. The outlet from the drum gate is greater in area than the inlet from the steel chute, so that any piece of coal that enters the gate can pass out into the weighing bucket. Owing to the feed from the side, instead of the perpendicular feed, only a small quantity of coal is carried at any time on the floor of the drum gate, so that when the gate is closed there is not a heavy head of coal upon it. When the gate is opened, and the power to open it is very much less than was previously found necessary, the material having plenty of space in the drum gate moves with the gate and there is but little friction due to a head of coal upon the gate, so that this gate readily opens and allows the coal to pass into the weighing bucket.

The drum gate is of a revolving type. At the beginning of the weighing it is wide open and a full feed of material enters the weighing bucket. When the weighing is nearly completed the gate revolves, cutting off the feed to a small flow, and when the hopper has received its quota, the gate completes its arc and finally cuts off the supply. Should a large piece of coal be in the gate as the scent from the chute to the gate as the gate cuts off, it cannot prevent the gate from closing, and is thrown to the back of the drum gate. The gate is locked by means of a simple linkage on the dead center principle. The discharge from the weigh hopper is also controlled by means of a toggle on the same principle. Heretofore the gate has been operated by means of a spring; in other words, the power exerted by the dead weights in the weight box at the one end of the equal armed beam has been cushioned in its descent by a spiral spring and the release of the gate controlling levers has allowed this spring to expand and open the gate. After a limited service all spiral springs are liable to become dead, and especially is this true in the case of heavy service springs. It has been found necessary to provide some cushioning medium between the weights and the gate and in the new Richardson scale a weight is introduced in place of the spring. By making the operating lever of a large multiplication it is possible to use quite a small "power" weight, on the extremity of this operating lever. As an example, the leverage may be six to one. When the scale hopper has discharged its load, the weights in the box at the other end of the beam are free to return to the stops on the side frames, but for the fact that the pressure is taken up by a pendant connected to the gate, and the gate locking levers being at a dead center the gate cannot open. The operating lever is raised, thus raising the operating weight. The air in the lower part of the piston passes through a small bye-pass pipe to the upper end of the cylinder and the cushioning takes place. The effect is the same as on door checks. This piston now is at the top and remains so because the gate controlling

levers are in their locked position. Directly the locks are broken by the trip mechanism on the hopper with which they come in contact after the hopper door is closed, the weight is free to fall, working on the fulcrum formed by the pin of the pendant. The fall of the weight is also cushioned in the same manner as its uprising, namely, the drawing of the air in passing from the top to the bottom, and vice versa. The bye-pass pipes are fitted with a regulating cock by which the retard can be regulated.

The cylinder proper is made of high-grade solid drawn brass tube, is fitted with oil cups and drain cock, and the piston rod is so fitted that no dirt can affect its operation. It is so fitted as to allow it to follow the arc formed by the operating lever with a minimum of friction. The cylinder is encased in a casting, which prevents damage by denting. The drum gate is mounted on roller bearings and is fitted with oil cups. All the levers are of cast steel, and wherever possible the pins are arranged with double shear.

In order to prevent any possibility of very small or wet coal adhereing to the base of the side feed sloping chute, and thus prevent a regular flow, a feeder is arranged in the chute. It consists of a reciprocating plate, arranged at the same angle as the chute. This plate is operated by eccentrics and the bottom of it is carried by two sliding blocks which work in slots in the casting of the chute. Thus the base of the coal pressing on the feeder is continually changing, being agitated forward, and a positive feed is obtained. The feeder is so arranged as to be in action only at the time the gate is open and the feed is taking place. Immediately the gate closes, the feeder ceases to operate. This is brought about by a connection between the gate spindle and a bell crank, which engages and disengages a clutch.

The weighing hopper is cut away at the base along the front to allow of a sure closing in case a piece of coal is between the body of the hopper and the door at the moment of the closing of the latter. By this arrangement it is impossible for the door to be held open through a piece of coal wedging between the hopper and the door. A flapper conceals the joint but at the same time hangs loose. The door of the weighing hopper is provided with roller bearings.

MULCONROY FLEXIBLE HOSE.

Flexible Rubber Hose.

THE attached illustration represents a piece of the Mulconroy "Dynamite" flexible metallic hose with wall cut and forced apart to better show how it is made. The rubber tube between the white dotted lines is the vital part and which has been protected inside and outside. This tube is protected first on the inside by a ply of heavy duck (see inside dotted white line) which is kept in place by the special spun steel wire shown on inside of hose. This special spun steel wire is kept in its proper position by being surrounded with a layer of pure rubber. This layer of pure rubber forms a perfect contact on nipples or stems of couplings, therefore any

regular couplings may be used. This protection absolutely prevents the tube from collapsing, as frequently occurs with hose of the ordinary make. It also prevents the nipples or stems of couplings from injuring the tube when they are applied. The tube is protected on the outside by a ply of heavy duck (see outside dotted white line) which in turn is covered with rubber. Over this are placed two braided coverings of non-rustable annealed steel wire. These coverings will stand a working pressure of over 2,000 lbs. per square inch. The inside braided cover will take care of all strain due to internal pressure and the outside cover will take care of all wear and abuse the hose may be subjected to. This hose is made by Mulconroy Company, 719 Arch street, Philadelphia, Pa.

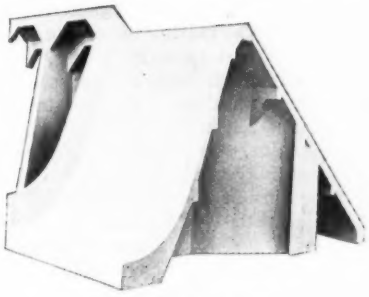
New Hydraulic Jacks.

ANYONE who has much heavy lifting to do appreciates that there are pleasanter tasks than carrying around a jack from one place to another, especially when it weighs more than a hundred pounds. It means rather a heavy load if carried by hand, and if the jack is loaded and reloaded onto a truck with each using, this involves considerable work too. The new Watson-Stillman shop jack, which we show in the illustration, renders unnecessary much of this labor. This jack, made in eleven sizes, of from 20 to 50 tons' capacity and lifts of 12 and 18 inches, fills all the ordinary requirements of lifting heavy machinery and for general shop work. The wheels on the base and the handle on the cylinder facilitate moving the jack quickly from one place to another without the exertion of a great deal of energy. The wheels touch the floor only when the jack is tilted, so they are never in the way during the lifting operation. If it is desired to use the jack at an angle, it can be tilted in the opposite direction to the wheels, and when it is laid flat upon the side, the ram will push out its entire lifting length. The head is enlarged sufficiently that the jack will not stop working for lack of filling, even if there has been slight leakage. An independent steel claw (not shown in the illustration) can be used when desired for lifting from near the ground. This is more convenient than a permanently attached claw, as the independent part is easily applied when a low lift is required, and its removal at other times allows the jack to be made of considerable lighter weight. The weight, however, is comparatively small because the whole jack is made from steel, and the parts under gratest strain, such as the ram and cylinder, are machined from a solid bar of higher carbon steel than usually found in hydraulic or other jacks. This jack, though plain in construction has proven very reliable in service, and on account of its special design greatly facilitates the handling of heavy equipment. It is made by the Watson-Stillman Company, 54 Church street, New York.

A NEW HYDRAULIC JACK.

A Departure in Dam Construction.

AS the physical properties of reinforced concrete become better known, its manifold adaptability, and salient advantages over many other materials of construction cause it to be found rapidly usurping the place of these other materials. Concrete has been used alone and in conjunction with other materials in solid dam construction; but we find with the advent of the Ransom hollow



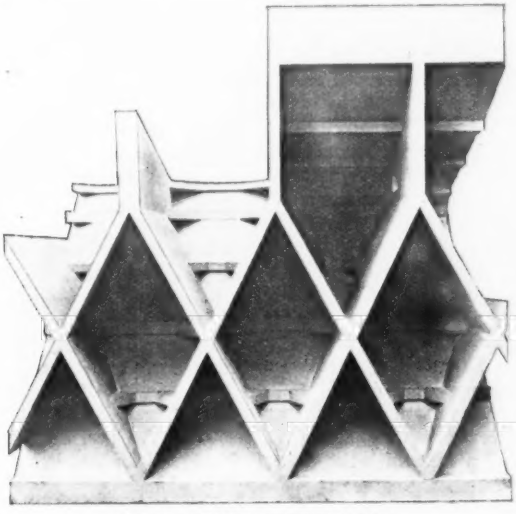
HOLLOW CONCRETE DAM.

dam a true reinforced concrete structure.

One of the accompanying photographs is a perspective view of a model of this type of construction for a dam forty feet in height. The foreground shows the roll-way and spillway, the background, the deck and crest. A glance at this model shows a monolithic construction and a disposition of materials to obtain maximum strength and rigidity. It represents a striking contrast when compared to the massive form of solid dam construction necessary to accomplish the same results. The actual saving of concrete between this type of hollow reinforced concrete dam and a solid dam of concrete, designed for the same site was about 1 to 1½.

An analytic analysis of the model makes it apparent that the resultant of all lines of force acting are well within its base. Thus the possibility of overturning, as well as the tendency of the structure to slide down stream, is overcome. Proper footings are of course used.

The second photograph is a view of the same model showing the appearance of the dam from the bottom up. In this are shown the diagonal walls—forming the cellular arrangement—peculiar to this dam, which gives it rigidity and overcomes vibration. Openings, not apparent, exist between compartments to allow for a free circulation of back water, —to overcome the possibility of entrapping air, and to supply a means of removing concrete forms. The bottom of the deck (extreme bottom of photograph) can, when necessary, be folded downward to any desired depth, thus cutting off percolation. In some instances, as an extra precaution, sheet piling is used, any desired portion of the top of which, is embedded in the concrete forming a part of the lower portion of the deck.



RANSOM HOLLOW CONCRETE DAM.

The concrete is reinforced where necessary, plain bars being used, as for example, on the tension side in the deck, in the arches which transfer the stresses from the deck to the walls, etc., the thickness of the concrete and size of reinforcement being varied for variation in stresses. The construction lends itself admirably to this variation of size of component parts for their respective stresses, and this effects an additonal economy.

Several practical examples of this method of dam construction are to be found, among them that across the Ware River at Barre, Mass., which gives an excellent idea of the stable appearance stokers, under Stirling boilers, shows repossessed by this type of hollow dam. Frank B. Gilbreth, 60 Broadway, New York, has obtained from the engineers controlling the patents the exclusive world agency to construct this dam.

Industrial Notes.

The Buffalo Gear & Pattern Works, 18-20 Elk street, Buffalo, N. Y., have built up an interesting specialty in the production of gear patterns. The demand for better gear patterns at a lower cost first induced them to install a special and complete line of machinery for the production of such gear patterns as would, by reason of their high mechanical perfection, produce cast gears of superior merit to cut gears, due to their qualities of strength, durability and equally good running. Considering the fact that the perfect action of gears depends primarily upon the correct form of the teeth, and that cut gear cutters usually cover a range of sizes and number of teeth varying from 25 to 40 per cent., the chances are that the gear, cast from a pattern for which the cutter was especially fitted, will give the best performance. Perfect patterns reduce the cost of molding.

The machinery covers the entire field of gear construction and embraces all styles and sizes, from the smallest to the largest, and thus they are able to meet even the most exacting special requirements. An interesting booklet on the construction of gear patterns will be sent to those making inquiry for it.

—The Erie City Iron Works, Erie, Pa., announce that they have secured exclusive American right to manufacture and sell in the United States the Lentz engine. This is the engine used so successfully at the mechanical irrigation stations of the Nile, described by J. B. Van Brussel in the February, 1909, issue of THE ENGINEERING MAGAZINE. The location and circumstances surrounding construction have made this one of the most interesting engineering problems of the time.

—The Macbeth Iron Company, of Cleveland, and the Bruce-Meriam-Abbott Company, also of Cleveland, were consolidated on June 1st, the name of the new company being the Bruce-Macbeth Engine Company. It is the purpose of the Bruce-Macbeth-Engine Company to continue the business of both the former companies on a much larger scale than before. The manufacture and development of the gas engine will be continued and the former line of work of the Macbeth Iron Company, the building of blowing engines, and general machine and foundry work, will be conducted as heretofore. It is the intention of the new company to concentrate the two present plants in the former plant of the Macbeth Iron Company. Alterations to the present buildings will be made and new buildings will be erected to accommodate the enlarged business. The officers of the company are as follows: President, W. C. Bruce; Vice-President, C. W. Kelly; Secretary and Treasurer, C. J. Snow; Manager, C. E. Curtiss. The above, with A. D. Macbeth, J. B. Merriam and F. B. Abbott, constitute the board of directors.

—H. V. Coes, formerly with the New York Edison Co., has accepted the position of mechanical engineer and assistant to the president of the Liquid Carbonic Co., with headquarters at 67 Wells street, Chicago, Ill.

Ernst Wiener Company, New York, N. Y., manufacturers of industrial cars and track, have appointed the W. K. Kenly Company of Chicago, as their district sales agents.

NEW CATALOGUES AND TRADE PUBLICATIONS.

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Boiler Tests.

UNDERFEED STOKER CO. OF AMERICA, Chicago.—Detailed official report, in typewritten form, together with blue prints, diagrams, etc., of the remarkable boiler tests recently carried out at the Union Gas & Electric Company's plant in Cincinnati, Ohio. Issued for the benefit of power users who desire to have exact copies of the detailed official records and reports. Free on application.

Blowers.

AMERICAN BLOWER CO., Detroit, Mich.—A small book entitled "Handbook of Information on Blowers and Exhausters for Forges and Furnaces." The aim is to enable a prospective purchaser to pick out the proper size and type of blower or exhaust fan for his requirements without the delays incident to correspondence. Many useful tables are included.

Cooling Towers.

GEORGE J. STOCKER, St. Louis, Mo.—Catalogue containing: (a) a short dissertation on the principles on which the cooling of water by this kind of apparatus depends; (b) a full and illustrated description of the different types of the Stocker cooling tower, with forced (fan) draft, with natural (vertical) draft, and open or so-called "atmospheric coolers" with natural draft, principally in horizontal direction; (c) their relative merits under varying atmospheric conditions and applications; (d) a discussion of the importance of the material used in the construction of the apparatus as affecting its efficiency and durability; (e) tables and diagram giving the possible maximum efficiency of the cooling tower in comparison with the practically obtainable results; (f) statements regarding the loss of water by evaporation and the power required for operating the pumps and fans. The pamphlet is accompanied by photos, showing recent typical installations of the Stocker cooling towers.

Chimney.

ALPHONS CUSTODIS CHIMNEY CONSTRUCTION CO., 95 Nassau Street, New York.—A well-illustrated pamphlet describing in detail the largest and highest chimney in the world, erected at the smelting works of the Boston and Montana Consolidated Copper and Silver Mining Co. at Great Falls, Montana. The chimney is built of common brick and mortar and rises 506 feet above its foundation.

Cranes and Hoists.

SHEPARD ELECTRIC CRANE & HOIST CO., 50 Church Street, New York.—Bulletin No. 502, illustrating and describing briefly several distinctive types of Shepard cranes and hoists. The builders are now producing electric hoists in more than 400 types and sizes adapted to every known service, capacities ranging from 500 pounds to 20 tons. The distinctive features of the Shepard design are complete protection and positive lubrication of the moving parts, and provision for the permanent correct alignment of these parts is found in the portable hoists as well as in the heavy cranes.

Draft Control.

GREEN FUEL ECONOMIZER CO., Matteawan, N. Y.—A handsomely illustrated pamphlet entitled "The Automatic Draft Control for Steam Roller Furnaces." It describes an approved appliance for so regulating the draft of steam boilers that the pressure within the firebox is at all times neutral. To accomplish this just enough pressure is supplied under the grates to force the air through the fuel, while enough draft is applied in the smoke flue to draw the gases of combustion through the boiler.

Electric Welding.

TOLEDO ELECTRIC WELDING CO., Toledo, Ohio.—Describing many types of electric welders for particular uses.

Electrical Conduit.

SPRAGUE ELECTRIC CO., 527 West 34th Street, New York.—Catalogue No. 424, describing various types of conduit, conductors, boxes, fittings, etc. Among the newer types will be noted the single strip flexible steel conduit, which is designed especially for fireproof construction.

Explosives.

NATIONAL POWDER CO., 353 Fifth Avenue, New York.—A well-illustrated catalogue of blasting supplies, dynamites of all descriptions, electric fuses and batteries, black blasting powders, etc., for mountain tunneling, railroading and road making, sub-marine work, quarrying and other blasting.

Foot Valve.

NEWMAN MFG. CO., 26 Cortlandt Street, New York.—Circular illustrating and describing the continuous service foot valve, underwriters' model. This valve was designed with a view of obviating automatically the trouble caused through the entry of refuse into the pipes of water systems.

Fences.

ANCHOR POST IRON WORKS, 25 Cortlandt Street, New York.—A catalogue of iron fences,

railings and entrance gates, particularly adapted for enclosing factories, mills, etc. The Anchor posts are made of high carbon steel, heavily galvanized by the hot dip process, making them rustproof. The stakes are driven into the solid ground and the form of the fence is such that it is unclimbable.

Graphite Products.

JOSEPH DIXON CRUCIBLE CO., Jersey City, N. J.—A small edition of the general catalogue listing crucibles, facings, lubricating graphite, greases, pencils, protective paint, etc., giving brief descriptions and prices. It is of value to the purchasing agent, engineer, contractor, superintendent or any one who uses or specifies graphite in any form.

Gauge Boards.

AMERICAN STEAM GAUGE & VALVE MFG. CO., Boston, Mass.—A brief catalogue showing gauge boards for American steam gauges, for engine, boiler, heating and other pressures. They can be furnished in any kind of marble or slate for any number of instruments, or may be had plain or fancy in oak, walnut, cherry, mahogany and cast iron.

Hydraulic Jacks.

JOYCE-CRIDLAND CO., Dayton, Ohio.—One of a series of books on elevating jacks. This one, Bulletin No. 33, relates particularly to hydraulic jacks, and describes a new speeding device by means of which the jack can be run quickly up to load, where the speed device automatically cuts out, and leaves the lifting pump only in operation. This device overcomes one of the chief objections to hydraulic jacks,—their slowness in running up to load.

Rock Drills.

WOOD DRILL WORKS, Paterson, N. J.—A booklet entitled "Wood Rock Drills," giving full description of these machines, showing their adaptability to tunnel driving, drilling in concrete, and open cut work, together with detailed costs in driving the Ticton Tunnel of the U. S. Reclamation Service at North Yakima, Wash.

Steam Turbines.

BALL & WOOD CO., Elizabethport, N. J.—A descriptive catalogue of the Rateau-Smoot turbines and generators. The Rateau-Smoot low-pressure turbine is operated by exhaust steam, making use of it between the limits of the pressure of the atmosphere and the vacuum obtained by means of a condenser. It is a turbine of the impulse type, the entire expansion of the steam taking place in the fixed vanes. As there is no expansion of steam in the moving vanes of the turbine there is no difference of pressure between the inlet and outlet sides of each rotor. Consequently there is no tendency for steam to leak past the tips of the blades.

Safety Valves.

CONSOLIDATED SAFETY VALVE CO., 85 Liberty Street, New York.—Contains a paper on safety valve capacity read before the American Society of Mechanical Engineers by Philip G. Darling. There are tables giving the capacities in pounds of steam per hour, of safety valves, and locomotive safety valve equipments based upon heating service, together with other data of interest to steam engineers.

Transformers.

WESTINGHOUSE ELECTRIC & MFG. CO., Pittsburg, Pa.—Circular No. 1502, containing much information on alternating-current distribution, covering transformers, lightning arresters, insulators, cross-arms, etc. Considerable space is devoted to underground and overhead construction applicable to congested and scattered districts.

Tube Blowers.

U. S. SPECIALTY MFG. CO., 1101 People's Bldg., Pittsburg, Pa.—Folder illustrating and describing a system for cleaning boiler tubes. This cleaner is a blower operated by steam or compressed air, steam being preferable because its use entails no losses of temperature. It blows the soot out of the tubes from the rear of the boiler, with the draft, through the uptake, thus effectually cleansing the tubes.

Time Systems.

INDUSTRIAL INSTRUMENT CO., Foxboro, Mass.—A bulletin describing the standard electric time systems as particularly developed for use in industrial and commercial plants. Standard time electric apparatus is automatic, exact, synchronous and of practical value in promoting economy in the use of time by operators and in systematizing and standardizing manufacturing operations.

Telephones.

WESTERN ELECTRIC CO., Chicago.—A small pamphlet describing automatic intercommunicating telephones in metal boxes for business and residence service. The apparatus is compactly mounted in a fireproof case, black Japan finish, and may be had for mounting on a wall or for setting into a wall.

Water Softener.

GEM CITY BOILER CO., Dayton, Ohio.—Descriptive catalogue of the Russell water softener and purifying system for steam plants and industrial purposes. The process consists of treating hard water by solutions of suitable chemicals, usually lime and soda ash, in order to precipitate the elements that are carried in and give the water its hardness, and a means of collecting the precipitate and removing it from the settling tank as sludge. The catalogue enumerates the sixteen requirements of a perfect water-softener system.

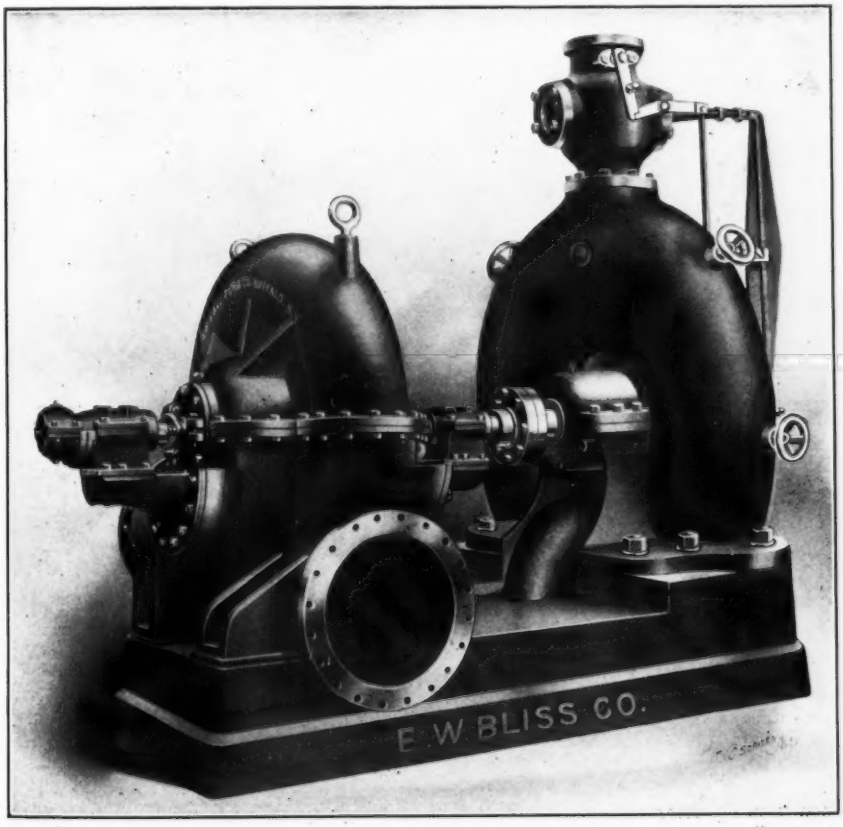
Water Wheels.

PELTON WATER WHEEL CO., San Francisco, Cal.—A pamphlet entitled "Tangential Water-Wheel Efficiencies." The subject of bucket design for tangential water wheels is exhaustively treated and in addition there is much valuable information for the hydraulic engineer regarding the discharges of water wheels in general and notes regarding automatic needle regulating nozzles.

THE CURRENT RECORD OF
IMPROVED MACHINERY
NEW METHODS NEW MATERIALS
NEW APPLIANCES

A New Steam Turbine.

THE E. W. Bliss Co. of Brooklyn, N. Y., have placed on the market a steam turbine on which they have been experimenting for several years past.

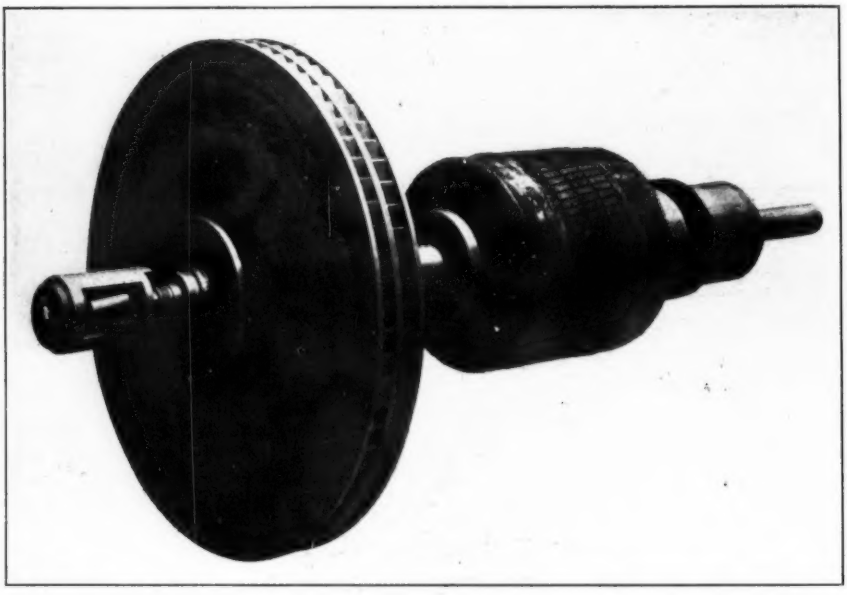


This turbine, which is shown clearly in the accompanying cuts, has been designed to meet the weaknesses of various other turbines on the market and to take advantage of their strong features.

Structural strength has been a point most eagerly sought for, and a glance at the figures showing the details of the Bliss turbine are convincing proof that there has been developed here a machine in which there is no danger of destroying vanes or guide blades.

The Bliss turbine is now being manu-

factured in all sizes up to 1,000 K. W. capacity, and it is being designed with a view of being applicable to industrial and other isolated plants as well as central stations. The designs include machines for both condensing and non-condensing, and also for turbines to run on the exhaust steam from reciprocating engines, so that the builders are in a position to satisfy the wants of a customer for power equipment under almost any conditions.



The exhaust steam turbine is especially adapted to manufacturing plants running at present through direct drive from a steam engine and extensions to the plant are planned. By installing a Bliss exhaust turbine, direct connected to a generator, and operating the unit on the exhaust steam which passes through the engine the addition, which is usually at some distance from the main plant, can be driven in this way much more economically by electricity than could possibly be done by direct drive. This method also makes the additional investment considerably less than by extending the direct drive, since no new boilers are required, and the operating cost will be very much less than by a direct drive.

A great many industrial plants of various descriptions are now considering seriously the question of changing over from direct to electrical drive, and are deterred from doing so on account of the great expense necessary, as well as by the fact that they are not quite sure whether this saving will be sufficient to pay for the additional fixed charges of such improvements. The exhaust turbine offers a very advantageous solution of this problem inasmuch as the part of the factory furthest from the power house, which is of course the portion which will derive the greatest benefit from the electrical drive, can be driven electrically by means of an exhaust turbine, while the larger part of the factory, which is closer to the power plant, can be operated by direct drive, which is fully as economical as the electric drive where the distances are short and countershafts few.

The exhaust steam machines are built from 75 K. W. to 1,000 K. W. capacity,

and the straight high pressure turbines from 10 K. W. capacity up, both condensing and non-condensing.

The general construction of the Bliss turbine is shown in the accompanying illustrations and description.

The casing is of cast-iron, having the steam chest carried concentrically around its outside and delivering the steam radially inward to each of the nozzles. The construction maintains an even temperature all around the circumference and does away with the necessity of having to bring any of the steam outside of the casing and then back into it again, as is necessary in some types of turbines. This is a very important point in the successful operation of the machine, as it is sometimes desired to look inside of the machine for inspection, and where it is necessary to break several steam joints this causes much trouble and annoyance.

The rotor or turbine wheel is made of one solid piece of open hearth steel, which has the bucket seats milled into the periphery, making a very substantial construction. The buckets are separated from each other by sheets of a special anti-corrosive metal, which are held in place by three steel bands shrunk on over the periphery. This method of construction makes a solid unbroken surface on the periphery of the wheel with no projecting parts, yet the wheel is as indestructible as it would be if no separating pieces were used, and has not the disadvantage of requiring a new wheel in case of any trivial accident like the damaging of a single bucket in transportation or handling. The running clearance is $^1/_{16}$", so that the machine cannot be considered delicate in this particular, and the construction is such that if by any combination of circumstances the turbine wheel should touch the casing, it would be a case of two smooth surfaces rubbing, like a brake shoe on a car wheel, and would cause no damage.

The steam is expanded completely in the nozzles, so that there is no difference in pressure between the buckets in the wheel and the reversing chamber, and consequently no loss from leakage. The reversing chamber is common for all reversals, so that the steam runs on a film of steam instead of on metal, which greatly reduces the frictional losses, as the relative difference in velocity of each layer of steam with respect to the next is very small. With separate reversing chambers the steam velocity relative to the metal is exceedingly high, and therefore causes large frictional losses, as the friction is very nearly proportional to the square of the relative velocities.

The number of times which the steam is used on the wheel depends upon the steam pressure and the speed of the buckets, and in this nozzle the steam continues to strike the wheel as long as there is any energy in it, and not a fixed definite number of times irrespective of steam pressure and speed.

In most designs the rotor is overhung, primarily in order to make a two-bearing unit for fan, pump and generating sets; but four bearing units are built when desired by the customer and on all large machines. The center of gravity of the rotor is inside of the edge of the bearing, which is of the spherical type, and very generously proportioned.

As the only parts of the Bliss turbine requiring lubrication are the shaft bearings it is impossible for any oil to become mixed with the exhaust steam. The method of oiling the bearings is by a positive ring oiler, and gives a positive feed lubrication without the use of an external pump. The oil is held in the rapidly revolving channel-shaped rings by centrifugal force and is positively diverted to the bottom of the bearing by means of a scoop. This produces a positive oil pressure in the bearing at all times, whereas in the ordinary ring oiler much of the oil flies off from the ring, and very little is actually forced to the bottom of the bearings, where the greatest pressure and need of lubrication exists.

The packing around the shaft is a steel labyrinth packing in which there is no contact between the stationary and rotating rings of the labyrinth. The packing prevents frictional losses and

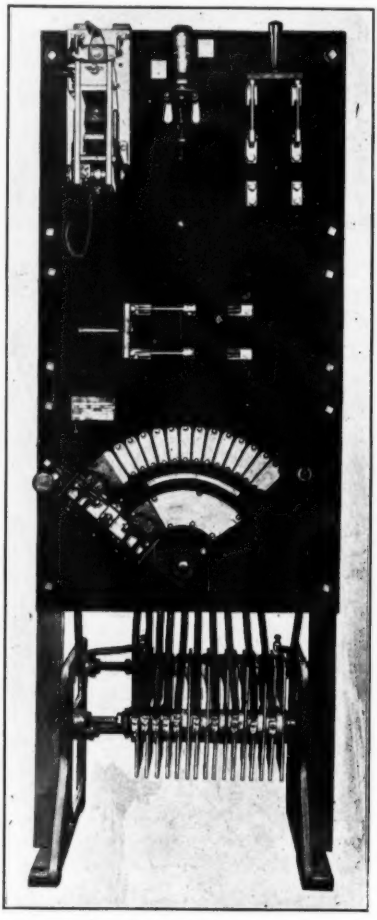
does away with the trouble attendant with carbon packings or stuffing-box packings around a high speed shaft.

The governor is of the centrifugal type, and consists of two revolving weights supported upon hardened steel knife edges, and controlling a balanced governor valve through knife-edge connections. In addition to the main governor there is an emergency governor entirely independent and operating a separate valve. This emergency governor is set at a predetermined speed above normal, and in case of any possible overspeed of the turbine for any reasons whatever the emergency valve will be closed, shutting down the machine.

Under the same conditions of steam pressure, back pressure and speed, the primary losses in efficiency in any turbine are caused by steam friction and leakage. In the Bliss turbine as the steam is expanded down to the back pressure in the nozzle there is no difference in pressure between any part of the wheel and the reversing chambers, which makes it possible to run with a very large clearance, and still have no loss.

New Line of Motor Starters.

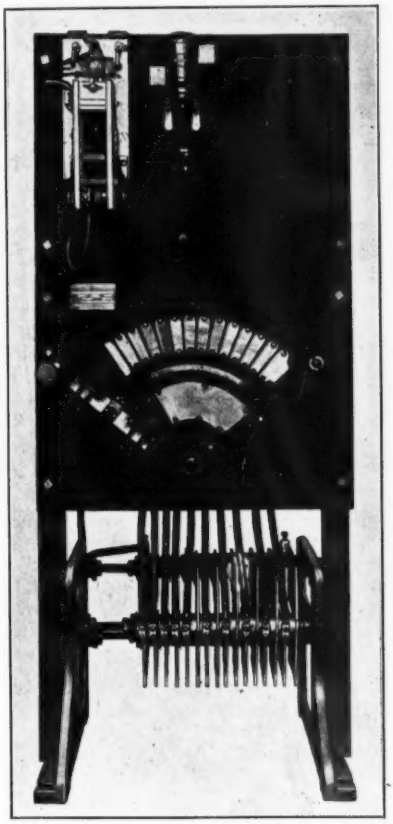
RECOGNIZING that there is a demand for a motor starter of rugged construction, the Electric Controller and Mfg. Co., of Cleveland, Ohio, has developed and placed on the market a new line of starters which are essentially of mill type design. In designing these mill type motor starters they have attempted to interpret severe operating conditions, and this has necessarily led to the use of some features not found in any previous motor starter. Mill type motor starters are made in panels, have supporting feet, and are completely self-contained. The dimensions of the different forms vary only in height. In width, nothing projects beyond the slates so that adjacent starters may be placed side by side, forming a continuous control board. The starters are furnished in several forms, beginning with a very simple form and elaborated on to embrace such features as no voltage release, overload protection for running, and separate and different overload protection for accelerating. In explanation of the last named feature, this design allows more current to flow through the motor during starting than during running. If a motor be connected to a load having large inertia—such as a hot saw or a press with a heavy fly wheel—the



mere accelerating of the load demands a very considerable expenditure of work. Since this starting is relatively infrequent, the motor will not be injured by employing a starting current in excess of the running current. Yet the starting time will be materially reduced. There are, in fact, numerous instances where

it is desirable to allow an accelerating current larger than the running current.

Experience has shown that no voltage protection which is secured by a spring return arm is open to the following serious objections: first, the spring is likely to be either broken or weakened, so that upon voltage failure the arm does not return to the off position; second, the contacts may become so roughened that the spring is not powerful enough to move the arm; third, an ignorant



operator may block the arm in the off position, so that it is impossible for the spring to perform its function properly.

If through any cause the arm is not returned to the off position upon voltage failure, the motor will necessarily be subjected to a damaging overload upon the return of voltage. In the mill type motor starters, the danger of a broken or weakened arm spring is absent, because no such spring is used. The no voltage protection is secured entirely by a magnetic switch which opens upon failure of voltage. This same magnetic switch in connection with an overload coil is used for securing overload protection. Since the overload feature must stand the abuse and have the characteristics of a circuit breaker, the Electric Controller and Mfg. Co. believes that it should possess the advantages and arc breaking ability of a circuit breaker.

The following valuable features summarize the operation of this type of motor starter: (1) The magnetic switch can be closed only by bringing the arm to the off position, preventing injurious overloads to the motor upon the return of voltage after voltage failure. (2) The magnetic switch can be held closed to the arm on any accelerating step only by holding in a push button. This prevents leaving any of the starting resistance permanently in circuit, and thereby burning out this resistance. (3) The magnetic switch will maintain itself closed only when the arm is at the full on position.

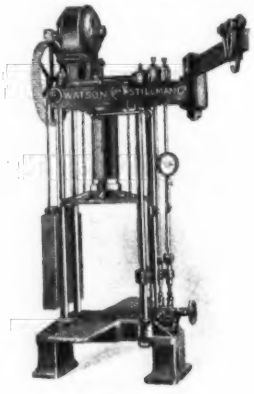
The resistance, fingers, contacts, etc., used in the mill type motor starters are of the same design and kind of material that the Electric Controller and Mfg. Co. use in controllers for heavy service. This motor starter can therefore be rightly called of mill type design, and is well able to stand the same abuse and severe service which the most ruggedly constructed mill type motor can be expected to encounter.

New Reversed Cylinder Press.

THE Watson-Stillman Company has just introduced a new reversed cylinder forcing press, which should prove a handy tool for pressing bearings and for miscellaneous work. As will be seen from the illustration a crane bracket and beam extending from one end enables the operator to swing a heavy piece of work onto bracket shelves extending out from each side of the bottom platen. These shelves, 30 inches long by 12 inches wide, are de-

tachable, can be lifted off on jobs where they would be in the way, and are sufficiently strong to support any work that will go into the machine. They will be appreciated by those who have had to push castings or parts into place on the ordinary small platen.

The motor, mounted upon pedestals



on top of the press, drives the pump shaft through single reduction gearing. A hand or belted drive is furnished, if desired, instead of the motor. On the other end of the pump shaft are two eccentrics each driving one of the pistons of a ¾-inch by 2-inch twin pump, for which the pedestal legs act as reservoirs.

The operating valve is of the single screw stem type, and connected to release the pressure from the work when opened, and start the ram down when closed. It will not retain the pressure unless the motor is stopped or the liquid driven through the safety valve. Other types of valves may be substituted to meet special conditions.

Literature descriptive of this and many other assembling presses may be obtained by addressing the manufacturers, the Watson-Stillman Company, 50 Church street, New York.

Personal.

—James Bennett Forsyth, president and general manager of the Boston Belting Co., died at Boston, Mass., June 11th last.

—Joseph W. Thompson, inventor of the steam engine indicator bearing the name of American-Thompson and made by the American Steam Gauge & Valve Mfg. Co., Boston, died at Salem, Ohio, July 15th. Mr. Thompson was associated with the Buckeye Engine Co., Salem, Ohio, for many years and was the inventor of many features of that engine, particularly the valve mechanism and the automatic governor.

Industrial Notes.

—We are informed by H. C. Blake, secretary of the Foos Gas Engine Co., of Springfield, Ohio, that their business during the past three months was larger by considerable than that of the same month of any previous year. The month of April showed the largest business ever done by the company in a single month, and the first five months of the present year show a greater business than has ever been done by the company in the same period. They are adding to their facilities, anticipating a still larger increase in business. This plant, which is the largest exclusively devoted to the gas engine business, is being worked 14 hours a day.

—The American Steam Gauge & Valve Mfg. Co., has received from the Newport News Shipbuilding & Dry Dock Co., an order for eight government composition triplex safety valves for the torpedo boat destroyers Roe and Terry. A similar order has been received from Wm. Cramp & Sons Ship & Engine Bldg. Co. for eight triplex valves for torpedo boat destroyers Nos. 30 and 31.

—Wm. B. Scaife & Sons Co., Pittsburg, Pa., manufacturers of the Scaife and We-Fu-Go water softening, purifying and filter systems, have completed an addition to their plant at Oakmont, Pa., to accommodate their increased business in the building of systems for the purification of water for steam boilers, industrial and domestic uses. The investigation on the part of manufacturers using steam boilers and water in industrial processes, has meant a continued increase in the number of We-Fu-Go and Scaife water purifying systems installed. Some recent orders taken are from Fox River Paper Co., Appleton, Wis.; Pittsburg-Buffalo Co., Burgettstown, Pa.; American Sheet & Tin Plate Co., Vander-

grift, Pa.; Penna. Salt Mfg. Co., Natrona, Pa.; Eastman Kodak Co., Rochester, N. Y.; Verner Coal & Coke Co., Bulger, Pa.; Warwick Iron & Steel Co., Pottstown, Pa.; Youngstown Sheet & Tube Co., Youngstown, O.; Fuchs & Lang Mfg. Co., Rutherford, N. J.; New England Butt Co., Providence, R. I.

—The Turner Construction Co., New York, have recently been awarded the contract for the model factory No. 4 for the Bush Terminal Co., Brooklyn, N. Y. This building will be of reinforced concrete throughout, and will be 750 by 75 feet, 6 stories in height.

—On the first of July the firm of Burnham, Williams & Co. was dissolved and their entire property and interests in the locomotive business were sold to the Baldwin Locomotive Works, Philadelphia.

—The Dodge Manufacturing Company is in the midst of plant extension work at the factory in Mishawaka, Ind. The main or south machine shop is being enlarged by the erection of a large addition which, when ready for occupancy, will be a complete building itself. The addition is 280 feet long and 122 feet wide, like the older portions of the shop, but the side bays will be higher to accommodate a second floor or gallery. The frame work of the structure is of steel, the supporting columns resting on concrete foundations. A cream brick is being used for the walls, with metal sashes. When the old shop is thrown into that under construction the total length will be 585 feet on the crane runway in the center bay. Two electric traveling cranes—25 tons and 10 tons respectively—will serve the main middle bay, where all machines are placed and where all heavy work is done. In the side bays several lighter electric cranes will handle the smaller work. The top floor will be devoted to the production of Dodge split friction clutches, this department of the Dodge works being overcrowded by the continued growth of the business, even though at this time it covers a space of more than 12,000 square feet. Elevators will be used between the two floors.

—J. A. & W. Bird & Co., Boston, Mass., have established a branch office at 55 Kennesaw avenue, Atlanta, Ga. The manager is P. J. Everett.

—H. G. Nicholls, for several years assistant general manager of the Canadian General Electric Company and the Canada Foundry Company, has resigned that position in order to go into business for himself. He has organized a company called Factory Products, Limited, with offices in the Confederation Life Building, Toronto, for the purpose of acting as Canadian selling agents for representative manufacturers.

—Joseph H. Williamson, for eighteen years business manager of the Manufacturers' Advertising Bureau of New York, and for seven years business manager of the Viennot Advertising Agency of Philadelphia, has opened an office at 719 Temple Court, New York, as a representative of trade journals.

—On July 1st Benjamin Whittaker resigned as treasurer of J. H. Williams & Co., drop-forgings, Brooklyn, New York, and gives his entire time to the exporting business for the same company and others, with headquarters at 17 State street, New York.

NEW CATALOGUES AND TRADE PUBLICATIONS.

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Engine Balancing.

American Engine Co., Bound Brook, N. J.—The problem of balancing high-speed steam engines is discussed in a clear and exhaustive manner in this pamphlet. It is pointed out that balancing the ordinary simple engine is an impossibility without the use of "bob-weights," that is, reciprocating weights moving at right angles to the piston; further that any attempt at balancing in one direction introduces equal unbalanced forces in a direction at right angles. The author then proceeds to show how an engine can be balanced perfectly if two cylinders be suitably arranged and gives a

brief description of the American Angle Compound engine in which this idea is incorporated. It is pointed out that the perfect balance obtained makes it feasible to install this engine upon floors and in other places where vibration would be objectionable, also that the even turning moment incidentally secured makes it possible to use lighter fly wheels and results in less pressure upon bearing surfaces, besides giving more satisfactory operation of alternating current generators.

Gasolene Locomotives.

MILWAUKEE LOCOMOTIVE MFG. CO., Milwaukee, Wis.—Publication No. 100, showing many types of gasolene-driven locomotives for service in manufacturing plants, mills, lumber yards and camps, mines, plantations, quarries, railroad, electric railway, tunnel and canal construction, and general freight and passenger transportation. The gas motor combines features which overcome some of the difficulties inherent in other prime movers, especially in localities where the scarcity of water and the impossibility of obtaining suitable steam coal at reasonable prices make the use of steam and electrical motive power uncertain and costly.

Gas Producer.

THE SMOKELESS HEAT & POWER CO., Cleveland, Ohio.—This process consists essentially in mixing oil with air and vaporizing and gasifying the mixture, resulting in a perfectly mixed, colorless gas of from 700 and upwards B. t. u. per cubic foot, and a candle power from 10 to 20, according to requirements. There is no deposit left in any part of the apparatus, except a small percentage of oil which falls in the settling tank. No ash and no free carbon or coke can be found anywhere in the system. The gas when used in an ordinary mantle burner, burns with no smoke and gives a clear white light from the mantle. When burned in an open gas heater, the flame is a clear blue with no perceptible traces of smoke. When used in an internal combustion engine it burns clean, leaving no tar or acid formations which might be detrimental to the operation of the engine.

Quride.

QURIDE CO., Syracuse, N. Y.—Quride is produced by treating hides with a chemical process which changes the albuminoids to fibroids. This change renders the hide insoluble and reduces it to a homogeneous, hard, tough substance. The product is especially adapted for use on printing presses, folding machines, geared power pumps, blowers, gear-cutting machines, lathes, centrifugals, and wherever else a silent gear is desirable.

Recording Gauges.

THE BRISTOL CO., Waterbury, Conn.—A preliminary bulletin of Bristol's recording gauges for all commercial ranges of pressure and vacuum. Special charts for the Bristol gauges have been engraved to suit a multiplicity of requirements and new charts are added frequently.

Steam Engines.

THE BALL ENGINE CO., Erie, Pa.—Catalogue P, showing steam engines of the side crank type, which has been adopted by the builders because of its peculiar adaptation to usual conditions of service. It avoids the undesirable feature of an overhanging wheel, which in the case of belt-driving constantly tends to wear the bearings out of line, and is particularly objectionable where alternating-current generators are driven direct, because of the heavy wheels usually required for this work. The side crank construction also eliminates the necessity for three bearings in engines direct connected to generators.

Water Purification.

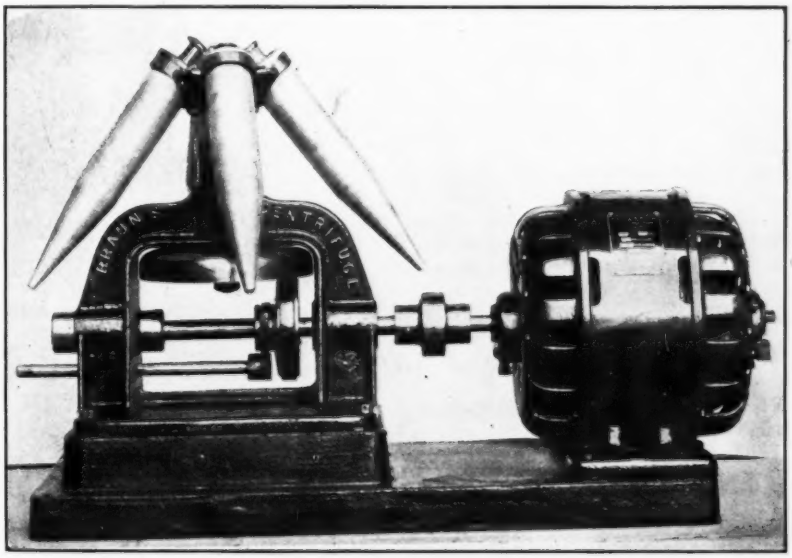
WM. B. SCAIFE & SONS CO., Pittsburg, Pa.—Catalogue in two colors, illustrating the Scaife and We-Fu-Go systems of water softening, purifying and filtering. The catalogue is notable for its many illustrations and admirable descriptions of the various types of water softening and purifying systems built by this company.

HARRISON SAFETY BOILER WORKS, Philadelphia, Pa.—Two charts showing that the purification of water for boiler feeding purposes can be accomplished in a commercially successful manner by the proper application of heat and soda ash—that is, that these two remedies will entirely protect the boilers from corrosion and from the formation of hard scale. Since heating water by spraying through steam takes the place of the caustic lime or caustic soda used in some processes for taking up carbon dioxide, this hot process system is claimed to be the rational method of converting cold hard water into hot soft water for boiler-feed purposes. The hot process apparatus designed and built by the above company combines the functions of an open feed-water heater with those of a softening system, and the fact that a feed-water heater should be installed in any case makes it comparatively inexpensive to secure softening in addition.

THE CURRENT RECORD OF
IMPROVED MACHINERY
NEW METHODS NEW MATERIALS
NEW APPLIANCES

A Motor-Driven Centrifuge.

MIXTURES of liquids of different specific gravities, or liquids containing sediments, may be separated in the course of time by the simple process of settling under the force of gravitation. But if the liquid be viscous, the difference in weight comparatively slight, or, as most frequently arises, the separation must be carried out quickly in order to make an analysis without delay, some greater force than that of gravitation must be called into play. This is most conveniently supplied by rotating the materials at a high speed, setting up centrifugal forces many times that of gravity. In the motor-driven centrifuge used for this kind of separation, and which, as shown in the accompanying illustration, consists of pivoted receptacles mounted to rotate about a vertical axis, the speed reaches more than 1,500 revolutions per minute. Under these conditions the pound mass of the centrifuge tube exerts a centrifugal pull of about 320 pounds, so that a sort of artificial gravitation is produced, 320 times as strong, and consequently 320 times as effective in separating mixtures, as the force of gravity. Since the containers swing out horizontally when in use, the centrifugal force on the material in their extreme tips is about twice that at the center of gravity of the containers. Accordingly separations can be made with this apparatus in a very short time, while the adjustable-speed friction drive enables the tubes to be started gradually,

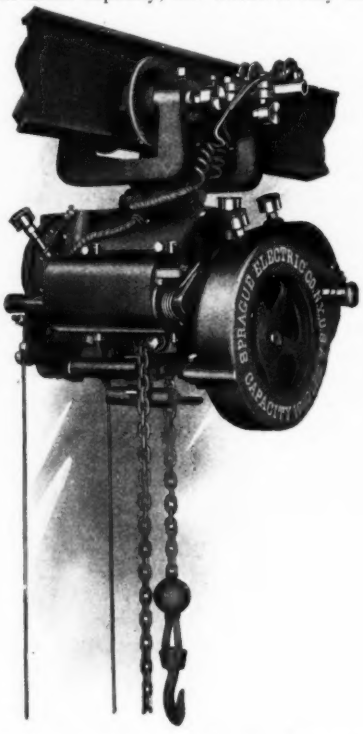


and brought up to any desired speed. The little motor shown, a quarter horse-power type A Westinghouse, is direct-connected to the friction-wheel shaft, which communicates its motion to the face-wheel, giving a range of 1,000 to 2,000 revolutions per minute. The glass container tubes are surrounded by water and enclosed in an aluminum case, furnishing a cushioning surface which prevents breakage. The tubes contain 100 cubic centimeters, and are calibrated to tenths of a cubic centimeter, so that the results are easily and quickly read off. The Braum centrifuge is manufactured by F. W. Braun, Los Angeles, Cal.

Electric Half-Ton Hoist.

THIS machine is designed for lifting any kind of load. Without load it weighs two hundred and thirty pounds, and it is twenty-five and a half inches high, twenty-one inches wide and eighteen and one-half inches thick. The motor is wound for 115, 230 or 500 volts, direct current, is fully enclosed and dust and weatherproof. The load is lifted by a chain and pocket wheel, the speed reduction for the pocket wheel consisting of a double reduction train of spur gears protected by casings. The gears are cut from solid blanks, and all lubrication is by grease cup fed through compression cups.

The first cost of this hoist is low enough to permit of its installation over individual tools in the machine shop, or its general use in artificial ice plants and industrial establishments where the erection of a comprehensive runway system is impossible, either on account of first cost or because the buildings are not strong enough to support a long runway. In such cases light jibs can be placed at points where the loads are stored, the hoist and carriage running back and forward on the boom. These jibs are very inexpensive, and can be attached to a building column if it is available, or supplied with a mast, making them entirely independent of the building for support. In small power stations and boiler rooms they are extremely convenient to aid in the disposal of ashes and in carrying coal to the furnaces; and in shipping rooms they can be used to load trucks with light packages, greatly economizing labor. The amount of headroom taken up compares very favorably with a chain block of equivalent capacity, for which it may be



substituted, thereby making a large saving in labor charges. The hoisting speed of the electric hoist is many times greater than the fastest speed possible with a chain block. The hoist shown herewith is made by the Sprague Electric Co., 527-531 West 34th street, New York.

High Speed Twist Drills.

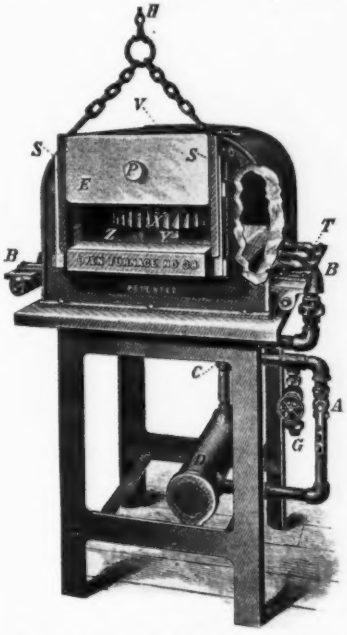
THE attached illustration shows the "Reliance" high speed twist drill made by the New Process Twist Drill Co., Taunton, Mass. These drills are made from flat bar stock, twisted while

hot, inserted into a tool shank, and brazed together by an improved method of inserting and brazing. It is possible to make a drill that will not work loose

in the shank and is practically one piece of steel. There are several drills on the market, made from flat bar stock, which require special sockets or chucks for driving them. The "Reliance" drills, however, are made with the regular Morse taper shanks, which have been on the market for years and have a positive drive. It is not necessary, therefore, to use any special chucks or sockets. The New Process Twist Drill Co. have issued a small pamphlet on this subject which they will send free on request.

Hardening "High Speed" Tools.

THE accompanying illustration is a view of one of the types of gas blast furnaces for hardening high speed tools made by the American Gas Furnace Co., 24 John street, New York. Previous to the production of these furnaces it was deemed necessary to heat high speed tools in lead, which was brought to a white heat in black lead crucibles. It was difficult, by this method, to obtain the required high temperature, and the cost of crucibles and of the lead which was rapidly volatilized seemed to make the process needlessly expensive. At the instance of some prominent manufacturers of high speed steel the American Gas Furnace Co. undertook a series of experiments to determine the best means of hardening different kinds of tools in gas blast furnaces. These experiments were successful and resulted in the manufacture of this line of furnaces for heating high speed steel tools. Each furnace is best adapted to particular kinds of tools, although each type may be used for heating a considerable variety of tools. For instance, a special furnace is made for heating reamers, drills, taps and other work of considerable length and small diameter. Such tools may be heated in the type of furnace illustrated herewith, which is made particularly for milling cutters, but if used for reamers and drills of considerable length they may warp from being unevenly supported. In the cylindrical furnace, specially designed for such tools, each piece is suspended in the heating space by its shank, and is removed after heating without



contact with the linings or supports, thus preventing injury to fine cutting edges softened by the high heat.

High speed tools properly heated in these furnaces will not crack, warp, scale nor lose their shape or size.

Some kinds of high speed steel harden at a lower heat than others, but for all brands these furnaces will answer as the temperature can be accurately controlled.

The American Gas Furnace Co. have published a special pamphlet on hardening high speed tools which they will send free on request.

Cast Steel Cement.

THE Clark Cast Steel Cement Co., Shelton, Conn., are placing on the market a cast steel cement for perfecting iron and steel castings. It fills blowholes, cracks, cold shuts and other defects. It is not intended as a temporary filler or smooth-over, but it is permanent in adhesiveness, hardness and color, and a perfect match for the castings in every respect. Its form is a fine metallic powder which, when mixed with the liquid accompanying it, forms a cement absolutely unaffected by water, steam, or oil.

In fact it will set hard in boiling water. In setting, it expands so much that it will stop a crack or leak absolutely tight against a water pressure of 3,000 pounds. Cement for joints made of lead and oil will not become hard for days, and will always soften again upon coming in contact with oil. Compounds which are mixed with water are quicker to set but are softened and destroyed by hot water, steam, and oil. This cement contains no oil or water and becomes permanently hard in ordinary temperatures in 24 hours, and at about 200 degrees Fahrenheit will harden in 15 minutes. It is, therefore, excellent for a cracked cylinder, as the hot metal of the cylinder jacket will harden the cement in the crack in a very few minutes. The illustration herewith shows a cracked cylinder which can be made perfect by an application of this cement.

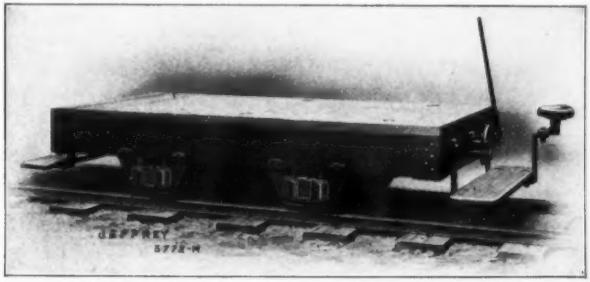
Highpower Drill.

ATTACHED is an illustration of a new high speed drill known as the "Highpower" drill made by the Pratt & Whitney Co., Hartford, Conn. The main feature, as will be seen in the illustration, lies in the continuous twist shown in the shank, thus permitting its use in the standard Morse or other taper sockets. The drill is ground, shank and barrel, thus giving it the same accurate

alignment as the standard milled drill. It will, therefore, drill with the same accuracy. As a result of the increased twist in the shank, the effective contact with the socket is greater than with the full surface shank, and therefore gives greater driving power. The breaking of tangs and slipping of drills in the socket is practically impossible.

Storage Battery Truck.

THE accompanying illustration shows a new yard truck just brought out by the Jeffrey Mfg. Company, Columbus, Ohio. The electrical equipment, including storage batteries, motor, controller,



with all necessary charging instruments, are all located below the platform so that the truck can be used for carrying material of any kind, or for hauling yard cars. The design is such that it can be used on any gauge from 18 inches up, and on the shortest curves encountered on industrial tracks. The electrical equipment is furnished in sizes to suit the service. For loads up to 10 tons a 6 H. P. motor with 10 K. W. battery is provided. For heavier service larger motors and batteries are supplied, depending on the maximum loads and the frequency of the trips. The platform is made removable, allowing easy access to the electrical equipment. For the service usually encountered around the average manufacturing plant, such as moving raw material, castings, etc., the 6 H. P. equipment will operate two or three days on a charge. By estimating the average weight and average length of trip the proper size equipment can be determined. The use of these cars facilitates the handling of material around a manufacturing plant, and also effects a very material saving in the cost of this work.

A Steel Hardening Solution.

FOR the hardening of carbon or tool steels the Metal Hardening Solution Company, Granite Building, Rochester, N. Y., is introducing a liquid chemical preparation known as "Kalux." It is emphasized that it is only for carbon or tool steel. Air hardening steels naturally have no use for it, and machine steel or iron cannot be hardened by it.

The action of hardening is produced by the shock caused when heated steel is immersed in a liquid of a much lower temperature than itself. This shock can only be obtained where carbon is present to a greater or less extent, as is always the case in tool steel, and cannot be looked for in other classes of steel or iron, where, although carbon is present, it is in graphitic or some other form, which does not respond to or expand to the same extent that the carbon in tool steel will. The action of any hardening bath, such as water or brine, on machine steel can have no effect whatever unless potassium cyanide or some other such chemical is used, and then the effect is only the surface, or penetrates but slightly, producing what is known as case hardening.

Carbon steels when heated to about 1450 degrees, the recognized heat for the majority of medium grade carbon steels, and plunged into one of the ordinary baths, such as water or brine, will almost invariably be short or brittle, unless tempered or drawn to color. This leads to one of the principal advantages of Kalux, where 1 ounce of this solution is added to each gallon of water in the hardening bath, the steel to be hardened can generally be heated to a lower temperature, say 1300 to 1350 degrees F., and where the tools have a cutting edge with heavy backing, such as

surface machine points, cross bit drills, etc., they can be left without drawing the temper more than enough to take the strain off, and it will be found that while they are hard they will still be tough and the length of service much prolonged. The danger of overheating and injuring the steel is minimized by permitting the tools to be hardened at this lower temperature; nevertheless, they are left hard, but tough, due to the action of the chemicals of which Kalux is composed, which have the effect of driving the molecules of carbon contained in the steel into a more homogeneous form than is possible with the higher heat generally found necessary to bring the steel out glass hard.

Personal.

—William D. McFarland of Washington, D. C., a brother of Walter M. McFarland, acting vice-president of the Westinghouse Electric & Manufacturing Company, died at his home in the capital, July 22, following an operation at the Johns Hopkins Hospital in Baltimore.

Industrial Notes.

—The Phosphor Bronze Smelting Company, Limited, Philadelphia, was dissolved on July 1st and all its property has been sold and transferred unto the Phosphor-Bronze Smelting Company, a corporation duly organized under the laws of the State of Pennsylvania, which corporation has assumed the performance and discharge of all the obligations and liabilities of the said association, and will hereafter carry on the same business formerly conducted by it.

—The U. S. Government has recently placed an order with The Foos Gas Engine Co., Springfield, Ohio, for six of their vertical engines to be used in the operation of locks on the Ohio river. The locks are operated by air, the four engines for driving the compressors being of 100 H. P. each, and the smaller ones used for auxiliary apparatus. The engines specified are the regular Foos vertical three-cylinder single-acting engines, using natural gas for fuel.

—The Turner Construction Co., 11 Broadway, New York, have just been awarded the following contracts: Two reinforced concrete warehouses, each 150 by 150 feet, six stories and basement, to be constructed for the Bush Terminal Co., South Brooklyn, N. Y., and a reinforced concrete warehouse, 100 by 50 feet, five stories and basement in height, for Hersh Bros., Newark, N. J.

—The Western Electric Company has made a contract with the Chinese government to supply a complete common battery telephone plant for the city of Pekin. This order was secured by the American company only after the most strenuous competition, in which the largest telephone manufacturers of the world figured. Heretofore almost nothing in the way of telephone development has been accomplished in China. There have been telephones in only a few of the cities, and these largely in the foreign quarters, which were served by small out-of-date systems. The two switchboards sold by the Western Electric Company to the government are the first common battery boards in the entire empire, yet China has an estimated population of over 400,000,000. Our own country, with a population but one-fifth as large, has more than 1,000 telephone exchanges larger than the two intended for Pekin, besides fully 15,000 smaller ones in smaller cities and towns.

—The following concerns have recently placed exhibits and offices in the exhibition and selling department of the Philadelphia Bourse: L. J. Wing Mfg. Co., New York, fans and boiler room equipments; Brown & Sharpe Mfg. Co., tools; August Mietz, New York, gas and oil engines; De La Vergne Machine Co., New York, gas and oil engines, refrigerating and ice making machinery; Hires Engineering Co., Philadelphia, Pa., steam pumps; John G. Horton, Philadelphia, Pa., patent barrels and by-products; Trenton Engine Co., Trenton, N. J., steam and gas engines; American Diagraph Co., St. Louis, Mo., stencil cutting machines.

—At the recent annual meeting of the stockholders of the Wheeler Condenser

& Engineering Co., Cartaret, N. J., J. J. Brown was elected vice-president and general manager. Mr. Brown entered the condenser field some fifteen years ago as southwestern manager for the Henry R. Worthington Co., and later became their general sales manager. After the formation of the International Steam Pump Co. he became their general western sales manager with headquarters at Chicago, and resigned that position to take up his present work.

—Benjamin R. Western and W. Hull Western, respectively proprietor and manager of the Manufacturers' Advertising Bureau, New York, and Walter Mueller and W. H. Denney, respectively president and treasurer of The Banning Company, New York, have organized the Manufacturers' Publicity Corporation. The officers of the corporation are Benjamin R. Western, president; Walter Mueller, vice-president and general manager; W. H. Denney, treasurer; and W. Hull Western, secretary. The offices are located at the Hudson Terminal Building, 30 Church street, New York.

—The Boston Belting Co. has recently made in one continuous length 1,170 feet of its Forsyth braided hose. This is the longest continuous length of hose, it is said, which has ever been produced, and is an indication that the Boston Belting Co. is fully equipped to meet the growing demand for long length hose. For years, efforts have been made to make hose in such long lengths as this, but it has only recently been achieved.

—Mr. H. von Schon, M. A. Soc. C. E., whose principal office is in Detroit, Michigan, following hydro-electric practice as a specialty, has arranged with Mr. Thatcher T. P. Luquer, C. E., to represent him in New York, with office at 103 Park Avenue.

—The manufacturers of the Taylor gravity underfeed stoker report through their New York agents, the Lenher Engineering Co., the sale of fourteen 7-retort stokers to the Philadelphia Electric Co. for their Christian street station.

—The B. F. Sturtevant Co., a Massachusetts corporation with a capital of $500,000, has been reorganized and recapitalized. The new corporation is organized under Massachusetts laws with $1,250,000 6 per cent cumulative preferred stock and $1,250,000 of common stock, and the stock has all been taken by a few of the large owners. The increased capitalization represents capital expenditures during the past year, largely in the erection of a new plant in Hyde Park which cost over $1,500,000.

—The Industrial Instrument Co. supply data on their instruments in the form of engineering bulletins, each bulletin being devoted to a certain line or class of meters, or to those instruments of different classes that group themselves conveniently for a certain industry. This method shares much of the elasticity of loose leaf catalogues without involving the trouble of their maintenance. It furthermore eliminates the formidable general ctalogue, only a small part of which is of interest to the average customers. The engineering bulletin treats one type or class of instruments exhaustively, without including irrelevant matter. The various bulletins published by this company are 8 by 11 in size and punched for binding together in substantial covers. These covers, or binders, and any bulletins will be sent to engineers interested in instruments upon application to The Industrial Instrument Co., Foxboro, Mass.

NEW CATALOGUES AND TRADE PUBLICATIONS.

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Centrifugal Pumps.

JEANESVILLE IRON WORKS CO., Hazleton, Pa.—Pamphlet illustrating the various types of centrifugal pumps made by this firm. Particular attention is drawn to the turbine boiler-feed pump. The continuous flow of fluid obtained from the centrifugal pump is distinctly desirable as compared

with the intermittent flow obtained from a reciprocating pump, which even flow reduces strains on valves and piping due to water hammer. Furthermore, by means of a governor on the steam turbine, the speed and consequently the delivery of the pump can be controlled from the boiler pressure and the water in these boilers maintained at a constant level. The governor on the steam turbine should be set so that the pump cannot operate beyond a certain fixed speed, which speed will limit the pressure generated, thus avoiding the possibility of disastrous shocks on the pipe line.

Drafting Machine.

EMMERT MFG. CO., Waynesboro, Pa.—Pamphlet describing the Noyes vertical or horizontal T-square. This instrument comprises a vertical T-square combined with a vertically sliding protractor carrying interchangeable scales, and guided by a steel track. Among the advantages pointed out are a gain in convenience and rapidity of work, a more healthful position of the draftsman, and the ability to make full-sized drawings of even very large parts.

Economizers.

GREEN FUEL ECONOMIZER CO., Matteawan, N. Y.—"How to Save Coal" is discussed from the point of view of recovering waste heat in the chimney flue gases in this booklet. It further describes the construction of the Green economier, illustrating the new extended top header, the new bottom header specially designed to avoid choking from soot, the new sectional covering and other improved features. There are several illustrations of large plants, such as the D., L. & W. terminal power plant, which have recently been equipped with Green economizers and Green mechanical draft fans.

Electric Lamps.

GENERAL ELECTRIC CO., Schenectady, N. Y.—Booklet entitled "A Revolution in Lighting Due to a New Lamp," telling in a simple way the advantages to be derived from the use of the tungsten lamp.

Foundry Furnishings.

DETROIT FOUNDRY SUPPLY CO., Detroit, Mich.—Catalogue of more than 400 pages showing a full line of foundry furnishings.

Grease Cup.

PHILADELPHIA LUBRICATOR & MFG. CO., Philadelphia, Pa.—Monograph on the lubrication of machinery bearings, referring particularly to the Philadelphia grease cup, which feeds grease by compressed air rather than by mechanical pressure.

Monel Metal Sheets.

A handsome illustrated pamphlet describing the wide range of uses to which Monel metal is adapted. It is non-erosive and non-corrosive and therefore specially adapted for roofing, cornices, smelter roofs, mine screens and chutes, and also for automobile parts, gaskets, smoke jacks, and for innumerable stamping and forming purposes—kitchen utensils, toilet fixtures, and products such as are made with a brass base and nickel-plated. The pamphlet is very complete in its detailed information and will be mailed free upon request to the American Sheet & Tin Plate Co., Pittsburg, Pa.

Portland Cement.

ALPHA PORTLAND CEMENT CO., Easton, Pa.—General catalogue on cement requirements, showing proper mixtures for various kinds of work, together with comparative statements of cost of cement work as compared with other materials.

Recording Machine.

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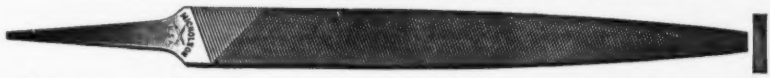

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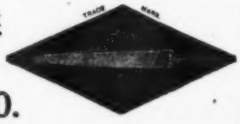

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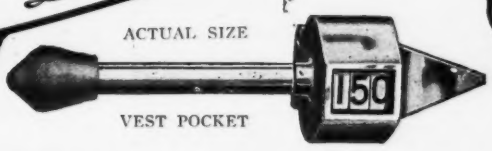

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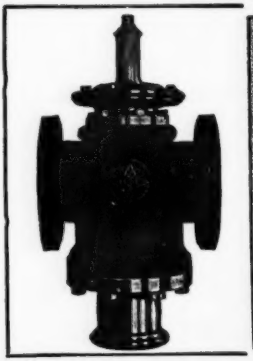

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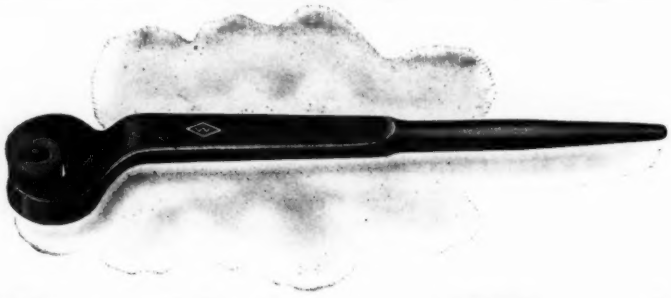

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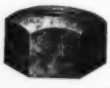

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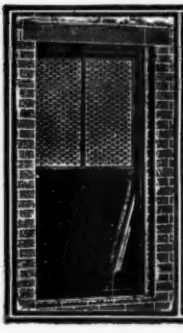

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CHARLES DAY *(The Planning and Building of Industrial Plants)*—Born 1879; graduated University of Pennsylvania (B.S.) 1899; took degree of M. E. on thesis 1901; superintendent installation of power-plant equipment and transmission machinery, Philadelphia Export Exposition; at its close entered employ of Link Belt Engineering Co., as assistant to superintendent and later engineer of works. After this plant had been thoroughly modernized, he and Mr. Dodge opened an office specializing on shop equipment and management; later, the scope of the organization was enlarged to include a great deal of engineering and construction work in both the industrial and public-service fields. Two years ago Mr. John E. Zimmermann became a partner in the firm of Dodge & Day. Member Am. Soc. Mech. Engineers, member of the Board of Managers and chairman mechanical and engineering section of the Franklin Institute, associate member Am. Inst. E. E., member New York Electrical Society, Philadelphia Engineers' Club, and Engineers' Club and Machinery Club, New York.

F. DARLINGTON *(The Substitution of Electric Power for Steam on American Railways)*—Graduated Pennsylvania State College 1896; one year in shop work, Phœnix Bridge and Iron Works; then employed in the laboratory of the Westinghouse Electric Co.; five years in electric-lighting and power business, New York, as electrical engineer for the combined interests of the United Electric Light and Power Co., the U. S. Illuminating Co. and the Brush Electric Illuminating Co.; for some years consulting engineer to the Stanley Electric & Mfg. Co., chiefly in railroad and power-transmission work; for five years with the Westinghouse E. & M. Co., Pittsburg, engaged mainly in engineering work relating to the application of electricity to railway operation; this position he still holds.

T. KENNARD THOMSON *(The Bridges of New York City)*—A specialist of ten years' experience in structural steel work and ten years in foundation work; has been bridge engineer for a railroad, chief engineer of a bridge company, and for eight years chief engineer for large contractors in addition to much consulting practice; he was retained on many New York sky-scrapers, including the Commercial Cable Building, Mutual Life, Manhattan Life addition, Trinity, U. S. Realty, City Investing and the forty-one-story Singer Building, and has designed many caissons. Member A. S. C. E., C. S. C. E., A. S. M. E., etc.

WILLIAM HERBERT HOBBS *(Construction in Earthquake Countries)*—Born Worcester, Mass., 1864; graduated Worcester Polytechnic Institute 1883; Fellow in Geology Johns Hopkins 1887-1888 (A. M., Ph. D.); studied at University of Heidelberg 1888-9; 1889-90 Curator Geological Museum; 1890-99 Assistant Professor and 1899 to 1906 Professor of Mineralogy and Petrology University of Wisconsin; 1906 to date Professor of Geology University of Michigan; 1896 to 1906 also connected with the U. S. Geological Survey. Contributor to Government reports and scientific and literary periodicals; Editor of the Bulletin of the University of Wisconsin. Fellow of the Geological Society of America; author of Earthquakes (D. Appleton & Co., 1907).

HOWARD S. KNOWLTON *(Labor Costs in the Central Station)*—Born in Worcester, Mass., 1878; graduate in electrical engineering, Worcester Polytechnic Institute, 1898; with General Electric Co., Schenectady works, 1898; with Boston Elevated Railway Co., 1899, 1900, and 1901, working on electrical and rapid-transit problems in connection with the building and operation of the elevated lines; consulting engineer, Natural Food Co., 1900-1; with Stone and Webster, engineering department, 1901-3; with Colorado Telephone Co., engineering department, 1903-4, engaged in high-tension crossing work in the Rocky Mountains, fire risks, and financial problems. For some time maintained headquarters in Denver, devoting his time to technical contributions. Now located in Newton, Mass.

AUTHORS AND PAPERS FOR SEPTEMBER, 1909.

H. F. STIMPSON *(Graphical Helps for Apportioning Time in Constructive Operations)*—Educated Massachusetts Public Schools, graduating from Lancaster High School in 1882; 1882-9 draftsman and assistant to several engineers, architects and manufacturers; 1889-93 assistant on buildings and equipment to the mechanical engineer of the General Electric Co., Lynn, Mass.; 1893-99 engineer and superintendent for Rand & Taylor, architects, Boston; 1899-1903 engineer for General Electric Co., Schenectady, in charge of an important real estate development; 1903 engineer with Westinghouse, Church, Kerr & Co.; 1905 developed the architectural department of Dodge & Day, Philadelphia; 1906 industrial and architectural engineer for the Roberts & Abbott Co., Cleveland; 1907-8 in private practice as industrial and architectural engineer; 1908-9 assistant engineer to Harrington Emerson, of the Emerson Co., New York, specialist in the saving of time and material in industrial plants. During the session of 1908-9, lectured on the design and construction of industrial buildings at Columbia University and has been reappointed for the session of 1909-10. Now in private practice as consulting engineer at 1 Madison avenue, New York.

ARTHUR SELWYN-BROWN *(Modern Cyaniding Practice and Machinery)*—Born Sydney, N. S. W.; graduated in civil and mechanical engineering at University College, London, and in arts, science, and law at New York University, studied chemistry and metallurgy with Sir William Ramsay, and mining engineering at various mines and works in England and Scotland; has had the management of large mining and engineering works in the United States, Canada, and elsewhere, and was one of the pioneers in the Tonopah and southern Nevada fields; his experience in tin mining has been extensive, and he has held the management of tin mines in Tasmania and several of the Australian states. Now consulting engineer in New York and lecturer on mining at the New York University, in the department of Commerce, Accounts and Finance.

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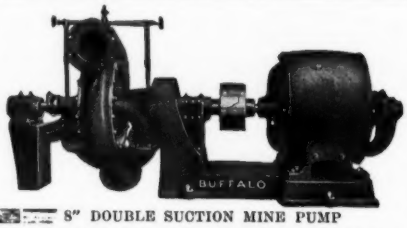

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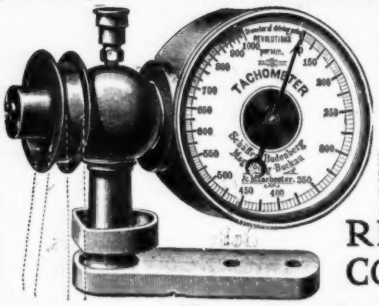

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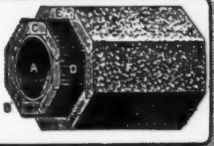

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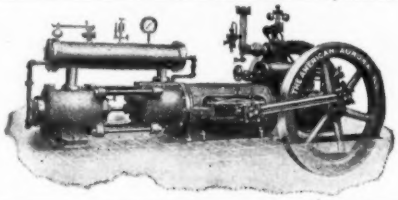

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The Buyers' Directory

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Phosphor Bronze Smelting Co., Phila.
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Belt Conveyors.
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Baker-Vawter Co., Chicago.
New York & Buffalo Audit Co., Buffalo.

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Mead-Morrison Mfg. Co., Boston.
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Fay & Egan Co., Cincinnati.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
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Phosphor Bronze Smelting Co., Phila.

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Cast-Iron Pipe.
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Walworth Mfg. Co., Boston.
Wood & Co., R. D., Phila., Pa.

Cement Machinery.
Bradley Pulverizer Co., Boston.
Caldwell & Sons Co., H. W., Chicago.
Dunning, W. D., Syracuse, N. Y.
Jeffrey Mfg. Co., Columbus.
Lehigh Car Wheel & Axle Works, Catasauqua, Pa.
Link-Belt Company, Philadelphia, Pa.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.
Ruggles-Coles Eng'g Co., New York.

Cement, Portland.
Alsen's Am. Portland Cement Co., New York.
American Cement Co., Phila.
Atlas Portland Cement Co., N. Y.
Glens Falls Portland Cement Co., Glens Falls, N. Y.
Lehigh Portland Cement Co., Allentown, Pa.
Pennsylvania Cement Co., New York.

Chains.
Diamond Chain & Mfg. Co., Indianapolis.
Link-Belt Company, Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.

Chain Belting.
Beaumont Co., R. H., Philadelphia.
Caldwell & Sons Co., H. W., Chicago.
Jeffrey Mfg. Co., Columbus.
Link-Belt Company, Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.

Chain Conveyors.
Beaumont Co., R. H., Philadelphia.
Link-Belt Company, Philadelphia, Pa.

Chain Joint.
Morse Chain Co., Ithaca, N. Y.

Chain Pipe & Fittings Wrenches.
Williams & Co., J. H., Brooklyn.

Channeling Machines.
Ingersoll-Rand Co., New York.

Checks, Time, Pay & Trade.
Schwerdtle Stamp Co., Bridgeport.

Chucks.
Almond Mfg. Co., Ashburnham, Mass.
American Tool & Mach. Co., Boston.
Niles-Bement-Pond Co., New York.

Circuit Breakers.
Electric Controller & Mfg. Co., Cleveland, O.

Clocks.
Standard Gauge Mfg. Co., Foxboro, Mass.

Clutches, Magnetic.
Cutler-Hammer Mfg. Co., Milwaukee.
Elec. Controller & Mfg. Co., Cleveland.

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Clutch Pulleys.
American Pulley Co., Philadelphia.
Caldwell & Sons Co., H. W., Chicago.
Link-Belt Company, Philadelphia, Pa.
Philips Pressed Steel Pulley Wks., Philadelphia.
Rockwood Mfg. Co., Indianapolis.

Coal and Ashes-Handling Machinery.
Beaumont Co., R. H., Philadelphia.
Brown Hoisting Mchy. Co., Cleveland.
Caldwell & Sons Co., H. W., Chicago.
Dodge Mfg. Co., Mishawaka, Ind.
Hayward Co., New York.
Interstate Engng. Co., Cleveland, O.
Jeffrey Mfg. Co., Columbus.
Lidgerwood Mfg. Co., New York.
Link-Belt Company, Philadelphia, Pa.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.

Coal Cutters (Air and Electric).
Igersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus.

Coal and Ore Bunkers.
Beaumont Co., R. H., Philadelphia.
Morris Co., I. P., Philadelphia.

Coal-Mining Machinery.
Blake Mfg. Co., Geo. F., New York.
General Electric Co., New York.
Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
Lambert Hoist. Engine Co., Newark
Link-Belt Company, Philadelphia, Pa.
McGowan Co., John H., Cincinnati.
Norwalk Iron Wks., So. Norwalk, Ct.
Robins Conveying Belt Co., Passaic, N. J.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Coal Screens.
Buffalo Wire Wks. Co., Buffalo, N.Y.
Harrington & King Perforating Co., Chicago.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.
Ludlow-Saylor Wire Co., St. Louis.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.

Cocks.
Jno. Simmons Co., New York.
Powell Co., Wm., Cincinnati.
Williams Valve Co., D. T. Cincinnati.
Wright Mfg. Co., Detroit.

Coil Pipe.
Jno. Simmons Co., New York.
National Pipe Bending Co., New Haven.
Whitlock Coil Pipe Co., Hartford.

Concrete Construction—Reinforced.
Gilbreth, Frank B., New York.

Concrete Mixers.
Carlin's Sons Co., Thomas, Pittsburg.
Dobbie Foundry & Machine Co., Niagara Falls.
Dunning, W. D., Syracuse, N. Y.
Interstate Engng. Co., Cleveland, O.
Jeffrey Mfg. Co., Columbus.

Concrete Piles.
Gilbreth, Frank B., New York.

Concrete Reinforcing.
American Steel & Wire Co., Chicago.
Buffalo Wire Wks. Co., Buffalo, N. Y.
Trussed Concrete Steel Co., Detroit.

Condensers.
Alberger Condenser Co., New York.
Blake Mfg. Co., Geo. F., New York.
Deane Steam Pump Co., New York.
Jeanesville Iron Works Co., Hazleton, Pa.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., N. Y.
McGowan Co., John H., Cincinnati.
Snow Steam Pump Wks., New York.
Struthers, Wells & Co., Warren, Pa.
Wheeler Condenser & Eng'g Co., N.Y.
Worthington, Henry R., New York.

Conduit Systems.
Gest, G. M., New York.

Continuous Elevators.
Caldwell & Son Co., H. W., Chicago.

Contractors, General.
Gilbreth, Frank B., New York.
White & Co., J. G., New York.

Contractors, Machy.
Carlin's Sons Co., Thomas, Pittsburg.

Controllers, Electric.
Cutler-Hammer Mfg. Co., Milwaukee.
Elec. Controller & Mfg. Co., Cleveland.

Conveying Machinery.
Brown Hoisting Mchy. Co., Cleveland.
Caldwell & Sons Co., H. W. Chicago.
Dobbie Foundry & Machine Co., Niagara Falls.
Dodge Mfg. Co., Mishawaka, Ind.
Hayward Co., The, New York.
Interstate Eng'g Co., Cleveland.
Jeffrey Mfg. Co., Columbus.
Lidgerwood Mfg. Co., New York.
Link-Belt Co., Phila.
Maris Bros., Philadelphia.
Mead-Morrison Mfg. Co., Boston.
Revere Rubber Co., Boston, Mass.
Robins Conveying Belt Co., Passaic, N. J.

Conveying Systems.
Sturtevant Co., B. F., Hyde Park, Mass.

Cooling Towers.
De La Vergne Mach. Co., New York.
Stocker, George J., St. Louis.
Wheeler Condenser & Eng'g Co., Carteret, N. J.
Worthington, Henry R., New York.

Copper Gaskets.
American Goetze-Gasket & Packing Co., New York.
Jno. Simmons Co., New York.

Coppersmiths.
Badger & Sons Co., E. B., Boston.

Copper Window Frames and Sashes.
Badger & Sons Co., E. B., Boston.

Cordage.
American Mfg. Co., New York.

Core Compound.
Obermayer Co., S., Cincinnati.

Cost Systems.
American Cost Accounting Co., New York.
Baker-Vawter Co., Chicago.
Knoeppel & Knoeppel, Erie, Pa.

Cotton Oil Machinery.
Laidlaw-Dunn-Gordon Co., New York.

Couplings.
Almond Mfg. Co., Ashburnham, Mass.
Caldwell & Son Co., H. W., Chicago.
Dodge Mfg. Co., Mishawaka, Ind.
Sellers & Co., Inc., Wm., Phila.

Couplings, Flexible.
Electric Controller & Mfg. Co., Cleveland, O.

Cranes.
Brown Hoisting Machy. Co., Cleveland.
Curtis & Co. Mfg. Co., St. Louis.
Dobbie Foundry & Machine Co., Niagara Falls.
Hayward Co., The New York.
Industrial Works, Bay City, Mich.
Interstate Engineering Co., Cleveland.
Link-Belt Company, Philadelphia, Pa.
Maris Bros., Philadelphia.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Riter-Conley Mfg. Co., Pittsburg.
Sellers & Co., Inc., Wm., Phila.
Wood & Co., R. D., Phila.

Crane Motors.
Western Electric Co., Chicago.

Crucibles.
Dixon Crucible Co., Jos., Jersey City.
Obermayer Co., S., Cincinnati.

Crushers, Ore, Phosphate, Rock.
Jeffrey Mfg. Co., Columbus.
Lehigh Car. Wheel & Axle Works, Catasauqua, Pa.

Cupolas.
Obermayer Co., S., Cincinnati.
Northern Engineering Works, Detroit.
Riter-Conley Mfg. Co., Pittsburg.

Cutters, Milling.
Pratt & Whitney Co., Hartford.

Cylinders.
U. S. Cast Iron Pipe & Fdy. Co., New York.

Damper Regulator.
D'Este Co., Julian, Boston.
Mason Regulator Co., Boston.

Derricks and Fittings.
Brown Hoisting Mchy. Co., Cleveland.
Carlin's Sons Co., Thomas, Pittsburgh.
Contractors' Plant Mfg. Co., Buffalo.
Dobbie Foundry & Machine Co., Niagara Falls.
Interstate Engng. Co., Cleveland, O.
Lidgerwood Mfg. Co., New York.
Northern Engineering Works, Detroit.

Digesters.
Atlantic Works, East Boston, Mass.
Riter-Conley Mfg. Co., Pittsburg.
Tippett & Wood, Phillipsburg, N. J.

Doors, Rolling.
Wilson Co., Jas. G., New York.

Draft, Mechanical.
American Blower Co., Detroit.
Buffalo Forge Co., Buffalo.
Green Fuel Economizer Co., Matteawan, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.
Wing Mfg. Co., L. J., New York.

Drafting Room Equipment.
Emmert Mfg. Co., Waynesboro, Pa
Keuffel & Esser Co., Hoboken, N. J.
Kolesch & Co., New York.
Weber & Co., F., Philadelphia.

Drawing Paper.
Keuffel & Esser Co., Hoboken, N. J.
Kolesch & Co., New York.

Drilling Machines.
American Tool Wks. Co., Cincinnati, Ohio.
Barnes Co., W. F. & J., Rockford, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Sellers Co., Inc., William, Phila.
Stow Flexible Shaft Co., Phila.
Stow Mfg. Co., Binghamton, N. Y.

Drills, Diamond Core.
Ingersoll-Rand Co., New York.
Terry Core Drill Co., New York.

Drills, Rail.
Buda Fdy. & Mfg. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.

Drills—Rock and Coal.
Ingersoll-Rand Co., New York.

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Jeffrey Mfg. Co., Columbus.
Terry Core Drill Co., New York.

Drop-Forged Wrenches.
Williams & Co., J. H., Brooklyn.

Drop Forgings.
Chicago Drop Forge & Fdy. Co., Kensington, Ill.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.
Williams & Co., J. H., Brooklyn.
Wyman & Gordon, Worcester, Mass.

Dryers.
Buffalo Fdy. & Mch. Co., Buffalo.
Ruggles Coles Engng. Co., New York.

Drying Apparatus.
American Blower Co., Detroit.
Buffalo Forge Co., Buffalo.
Sirocco Engng. Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Dumps, Automatic.
Jeffrey Mfg. Co., Columbus.

Dust Collecting Systems.
Ohio Blower Co., Cleveland.

Dynamite.
Simmamahoning Powder Co., Emporium, Pa.

Dynamometers.
Lawrence Machine Co., Lawrence, Mass.
Sprague Electric Co., New York.

Dynamos.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Jeffrey Mfg. Co., Columbus.
Northern Elec. Mfg. Co., Madison.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Dynamos, Steam Turbine.
De Laval Steam Turbine Co., Trenton.

Ejectors.
Buffalo Foundry & Machine Co., Buffalo.
Watson & McDaniel Co., Philadelphia.

Elbows, Pipe.
Whitlock Coil Pipe Co., Hartford.
Williams Valve Co., D. T., Cincinnati.

Electric Bells.
Ostrander & Co., W. R., New York.
Western Electric Co., Chicago.

Electric Fault Finders.
Electric Controller & Mfg. Co., Cleveland, O.

Electric Heating Apparatus.
Simplex Elec. Heating Co., Cambridgeport, Mass.
Western Electric Co., Chicago.

Electric Hoists.
Brown Hoisting Mchy. Co., Cleveland.
Dobbie Foundry & Machine Co., Niagara Falls.
Lambert Hoist Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., Boston.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit.
Sprague Electric Co., New York.
Western Electric Co., Chicago.

Elec. Light & Power Plants.
De La Vergne Mach Co., New York.
Foos Gas Engine Co., Springfield, O.

Electrical Furnaces.
Engelhard, Charles, New York.

Elec. Measuring Instruments.
Bristol Co., Waterbury, Conn.
Weston Elec. Instrument Co., Waverly Park, Newark, N. J.

Elec. Welding Outfits.
Brown, Wm. Hiram, Cleveland, O.
Garwood Electric Co., Garwood, N. J.

Elevating and Conveying
Beaumont Co., R. H., Philadelphia.
Caldwell & Son Co., H. W., Chicago.
Dobbie Foundry & Machine Co., Niagara Falls.
Dodge Mfg. Co., Mishawaka, Ind.
Interstate Engineering Co., Cleveland.
Jeffrey Mfg. Co., Columbus.
Lidgerwood Mfg. Co., New York.
Link-Belt Company, Philadelphia, Pa.
Maris Bros., Philadelphia.
Northern Engineering Works, Detroit.
Webster Mfg. Co., Chicago.

Elevator Insurance.
Fidelity & Casualty Co., New York.

Elevators.
Caldwell & Son Co., H. W., Chicago.
Curtis & Co. Mfg. Co., St. Louis.
Dodge Mfg. Co., Mishawaka, Ind.
Jeffrey Mfg. Co., Columbus.
Link-Belt Company, Philadelphia, Pa.
Mead-Morrison Mfg. Co., Boston.
Obermayer Co., S., Cincinnati.
Poole Eng'g Mch. Co., Baltimore.

Elevator Pressure Regulator.
Mason Regulator Co., Boston.

Employers' Liability Insurance.
Fidelity & Casualty Co., New York.

Engineering Instruments.
Altenedor & Sons, Theo., Phila.
Bausch & Lomb Optical Co., Rochester.
Berger & Sons, C. L., Boston, Mass.
Brandis Sons Co., Brooklyn.
Bristol Co., Waterbury, Conn.
Buff & Buff Mfg. Co., Boston.
Keuffel & Esser Co., New York.
Kolesch & Co., New York.
Queen & Co., Philadelphia.
Young & Sons, Philadelphia.

Engineering Specialties.
D'Este Co., Julian, Boston.
Industrial Inst. Co., Foxboro, Mass.
Industrial Supply & Equipment Co., Philadelphia.
Powell Co., Wm., Cincinnati.

Engineers.
Arnold Co., Chicago.
Barnaby, Charles W., New York.
Baum & Co., Frank G., San Francisco.
Brill, Geo. M., Chicago.
Collins, D. C. Newman, New York.
Crane Estate, M. H., Chicago.
Dobbie, Robt. McF., Denver, Colo.
Gas Power Co., New York.
Keyes & Son, F. E., New York.
Kennedy, Julian, Pittsburg.
Kennedy, Walter, Pittsburg.
Knoeppel & Knoeppel, Erie, Pa.
Link-Belt Company, Philadelphia, Pa.
Loomis-Pettibone Co., New York.
McClure, Son & Co., G. W., Pittsburg.
Moses, P. R., New York.
Perrigo, Oscar E., Boston, Mass.
Porter, H. F. J., New York.
Robinson, A. W., Montreal, Canada.
Roelker, H. B., New York.
Stimpson, Herbert F., New York.
Sutton, Frank, New York.
Thomson, T. Kennard, New York.
White & Co., J. G., New York.
Wood, George R., Pittsburg.

Engineers, Contracting.
Gilbreth, Frank B., New York.

Engines—Blowing.
Bruce-Macbeth Engine Co., Ohio.

Engines, Gas & Gasoline.
(See Gas and Gasoline Engines).

Engines, Marine.
Atlantic Works, East Boston, Mass.
De La Vergne Mach Co., New York.
Mietz, August, New York.

Engines, Steam.
American Blower Co., Detroit.
American Engine Co., Bound Brook, N. J.
Ball Engine Co., Erie, Pa.
Brown Hoisting Mchy. Co., Cleveland.
Buffalo Forge Co., Buffalo.
Harrisburg Fdy. & Mch. Wks., Harrisburg, Pa.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse, Church, Kerr & Co., New York.
Westinghouse Mch. Co., Pittsburg.

Evaporators.
Blake Mfg. Co., Geo. F., New York.
Knowles Steam Pump Wks., N. Y.

Excavators.
Hayward Co., The, New York.
Jeffrey Mfg. Co., Columbus.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.
Robins Conveying Belt Co., Passaic, N. J.

Exhaust Heads.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
Direct Separator Co., Syracuse.
Hoppes Mfg. Co., Springfield, Ohio.
Industrial Inst. Co., Foxboro, Mass.
McGowan Co., John H., Cincinnati, O.
Sturtevant Co., B. F., Hyde Park, Mass.
Watson & McDaniel Co., Phila.
Whitlock Coil Pipe Co., Hartford.
Wright Mfg. Co., Detroit.

Exhaust Heads (Cast Iron).
Hoppes Mfg. Co., Springfield, O.

Expanded Metal.
Roebling Construction Co., N. Y.

Explosives.
Du Pont-De Nemours Powder Co., E. I., Wilmington, Del.
Keystone Powder Mfg. Co., Penn.
Simmamahoning Powder Co., Emporium, Pa.

Fans, Electric.
Sprague Electric Co., New York.
Western Electric Co., Chicago.
Wing Mfg. Co., L. J., New York.

Fans, Ventilating.
American Blower Co., Detroit.
Buffalo Forge Co., Buffalo.
Green Fuel Economizer Co., Matteawan, N. Y.
Power Specialty Co., New York.
Sirocco Engng. Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago.
Wing Mfg. Co., L. J., New York.

Feed Water Heaters and Purifiers.
Alberger Condenser Co., New York.
Blake Mfg. Co., Geo. F., New York.
Dodge Mfg. Co., Mishawaka, Ind.
Goubert Mfg. Co., New York.
Green Fuel Economizer Co., Matteawan, N. Y.
Harrison Safety Boiler Wks., Phila.
Hoppes Mfg. Co., Springfield, O.
Keyes & Son, F. E., New York.
Knowles Steam Pump Wks., N. Y.
McGowan Co., John H., Cincinnati.
National Pipe Bending Co., New Haven.
Petroleum Iron Wks. Co., Sharon, Pa.
Ross Valve Mfg. Co., Troy.
Scaife & Sons Co., Wm. B., Pittsburg.
Webster & Co., Warren, Camden, N. J.
Wheeler Condenser & Eng'g Co., Carteret, N. J.
Whitlock Coil Pipe Co., Hartford.
Worthington, Henry R., New York.

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Safety Equipment Mfg. Co., Chicago.
Williams Gauge Co., Pittsburgh, Pa.

Felt Roofing.
Barrett Mfg. Co., New York.

Fences.
Anchor Post Iron Works, New York.

Fence Posts.
Anchor Post Iron Works, New York.

Fibre Rods, Tubes, Washers, etc.
Diamond State Fibre Co., Elsmere, Del.

Field Glasses.
Bausch & Lomb Optical Co., Rochester.

Files and Rasps.
Barnett Co., G. & H., Phila.
Carver File Works, Philadelphia.
Nicholson File Co., Providence.

Filter Presses.
Am. Tool & Machine Co., Boston.
Moore & Sons Corp., Samuel L., Elizabethport, N. J.
Niles-Bement-Pond Co., New York.

Filters.
Keyes & Son, F. E., New York.
Koven & Bro., L. O., New York.
Ross Valve Mfg. Co., Troy.
Scaife & Sons Co., Wm. B., Pittsburg.

Filters, Oil.
Industrial Inst. Co., Foxboro, Mass.
Wright Mfg. Co., Detroit.

Fire Brick
Harbison-Walker Refactories Co., Pittsburg, Pa.
Maurer & Son, Henry, New York.
Obermayer Co., S., Cincinnati.

Fire Clay.
Carborundum Co., Niagara Falls, N. Y.
Harbison-Walker Refactories Co., Pittsburg, Pa.

Fire Door Equipment.
Kinnear Mfg. Co., Columbus, O.
Wilson Co., Jas. G., New York.

Fire Extinguishers.
Badger & Sons Co., E. B., Boston.

Fire Hose.
Boston Belting Co., Boston.
Eureka Fire Hose Mfg. Co., New York.

Fireproof Building Materials.
Maurer & Son, Henry, New York.
Roebling Construction Co., New York.

Fireproof Doors.
Rapp, John W., New York.

Fireproofing.
Gilbreth, Frank B., New York.

Fittings.
Crane Estate, M. H., Chicago.
Jno. Simmons Co., New York.
Pittsburg Valve & Fittings Co., Barberton, Ohio.
Tight Joint Co., New York.

Fittings, Ammonia.
De La Vergne Mach. Co., New York.

Fittings, Electric Crane.
Electric Controller & Mfg. Co., Cleveland, O.

Flanges.
McGowan Co., John H., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati.

Flanges, Forged Steel.
Scully Steel & Iron Co., Chicago.

Flexible Shafts.
Stow Flexible Shaft Co., Phila.
Stow Mfg. Co., Binghamton, N. Y.

Flexible Steel Tubing.
Almond Mfg. Co., Ashburnham, Mass.

Floor and Sidewalk Lights.
Brooks & Co., T. H., Cleveland.

Fly Wheels.
Bruce-Macbeth Engine Co., Cleveland, O.
Dodge Mfg. Co., Mishawaka, Ind.
Poole Eng'g & Mch. Co., Baltimore.

Forges.
Buffalo Forge Co., Buffalo.
Ingersoll-Rand Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Iron and Steel.
Bruce-Macbeth Engine Co., Cleveland, O.
Chicago Drop Forge & Fdy. Co., Kensington, Ill.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester.

Foundations.
Gilbreth, Frank B., New York.

Foundry Equipment.
American Blower Co., Detroit.
Blake Mfg. Co., Geo. F., New York.
Buffalo Fdy. & Mach. Co., Buffalo.
Ingersoll-Rand Co., New York.
Northern Engineering Works, Detroit.
Obermayer Co., S., Cincinnati.

Foundry Riddles.
Buffalo Wire Wks. Co., Buffalo, N. Y.

Foundry Supplies.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati.

Friction Clutches.
American Pulley Co., Philadelphia.
Am. Tool & Mch. Co., Boston.
Caldwell & Son Co., H. W., Chicago.
Cutler-Hammer Mfg. Co., Milwaukee.
Farrell Fdy. & Mch. Co., Ansonia, Conn.
Link-Belt Company, Philadelphia, Pa.
Poole Eng'g & Mch. Co., Baltimore.

Frogs, Crossings & Switches.
Buda Fdy. & Mfg. Co., Chicago, Ill.

Fuel Economizers.
Green Fuel Economizer Co., Matteawan, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Furnace Builders.
Am. Gas Furnace Co., New York.
Continental Iron Works, Brooklyn.
Gas Power Co., New York.
Kennedy, Julian, Pittsburg.
McClure, Son & Co., G. W., Pittsburg.
Morgan Const. Co., Worcester.
Riter-Conley Mfg. Co., Pittsburg.
Tippett & Wood, Phillipsburg, N. J.

Fused Silica Wire.
Engelhard, Charles, New York.

Gages—Pressure, Steam, Water.
American Steam Gauge & Valve Mfg. Co., Boston.
Bristol Co., Waterbury, Conn.
Hohmann & Maurer Mfg. Co., Rochester.
Industrial Inst. Co., Foxboro, Mass.
Powell Co., Wm., Cincinnati.
Schaeffer & Budenberg Mfg. Co., Brooklyn.
Walworth Mfg. Co., Boston.
Williams Valve Co., D. T., Cincinnati.
Wright Mfg. Co., Detroit.

Galvanizing.
Koven & Bro., L. O., New York.

Galvanometers.
Weston Elec. Instrument Co., Waverly Park, Newark, N. J.

Gas Blowers & Exhausters.
American Blower Co., Detroit.
Buffalo Forge Co., Buffalo.
Sturtevant Co., B. F., Hyde Park, Mass.

Gas Compressors.
Bury Compressor Co., Erie, Pa.

Gas Engine Indicators.
Amer. Steam Gauge & Valve Mfg. Co., Boston.
Schaeffer & Budenberg Mfg. Co., Brooklyn.

Gas & Gasoline Engines.
Bruce-Macbeth Engine Co., Cleveland, O.
De La Vergne Machine Co., N. Y.
Du Bois Iron Works, Du Bois, Pa.
Foos Gas Engine Co., Springfield, O.
Mietz, August, New York.
Snow Steam Pump Works, New York.
Struthers, Wells & Co., Warren, Pa.
Westinghouse Mch. Co., Pittsburg.
Westinghouse, Church, Kerr & Co., New York.

Gas Machines & Generators.
Am. Gas Furnace Co., New York.
Gas Power Co., New York.
Morgan Const. Co., Worcester.
Wood & Co., R. D., Phila., Pa.

Gas Producers.
Bruce-Macbeth Engine Co., Cleveland, O.
De La Vergne Machine Co., New York.
Du Bois Iron Works, Du Bois, Pa.
Foos Gas Engine Co., Springfield, O.
Gas Power Co., New York.
Morgan Construction Co., Worcester.
Westinghouse Machine Co., Pittsburg.
Wood & Co., R. D., Phila., Pa.

Gaskets.
American Goetze-Gasket & Packing Co., New York.
Boston Belting Co., Boston.

Gear Cutting Machines.
Gleason Works, Rochester, N. Y.
Pratt & Whitney Co., Hartford.

Gearing.
Bilgram, Hugo, Phila.
Blake Mfg. Co., Geo. F., New York.
Buffalo Gear & Pattern Wks, Buffalo.
Caldwell & Son Co., H. W., Chicago.
Dodge Mfg. Co., Mishawaka, Ind.
Farrell Fdy. & Mch. Co., Ansonia, Conn.
Gleason Works, Rochester, N. Y.
Jeffrey Mfg. Co., Columbus.
Link-Belt Company, Philadelphia, Pa.
New Process Rawhide Co., Syracuse.
Nuttall Co., R. D., Pittsburg.
Philа. Gear Works, Inc., Philadelphia.
Poole Eng'g & Mch. Co., Baltimore.
Sellers Co., Inc., Wm., Phila.
Stow Flexible Shaft Co., Phila.

Gear Patterns.
Buffalo Gear & Pattern Works, Buffalo.

Generating Sets.
American Blower Co., Detroit.
Buffalo Forge Co., Buffalo.
Crocker-Wheeler Co., Ampere, N. J.
De La Vergne Machine Co., New York.
Mietz, August, New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago.

Gold Dredging Machinery.
Link-Belt Co., Philadelphia.

Graphite.
Dixon Crucible Co., Jos., Jersey City.
Obermayer Co., S., Cincinnati.

Grate Bars.
Bruce-Macbeth Engine Co., Cleveland, O.

Grates, Traveling Link.
Green Engineering Co., Chicago.

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Grinding Machinery.
Dodge Mfg. Co., Mishawaka, Ind.
Western Electric Co., Chicago.

Grinding & Polishing Mchy.
Crocker-Wheeler Co., Ampere, N. J.
Helwig Mfg. Co., St. Paul.
Landis Tool Co., Waynesboro, Pa.
Northern Elec. Mfg. Co., Madison.
Stow Flexible Shaft Co., Philadelphia.
Stow Mfg. Co., Binghamton, N. Y.

Grinding & Pulverizing Mchy
Bradley Pulverizer Co., Boston.
Dunning, W. D., Syracuse.
Lehigh Car, Wheel & Axle Works, Catasauqua, Pa.

Grinding Wheels.
Carborundum Co., Niagara Falls, N. Y.

Grinding Wheels (Alundum).
Norton Co., Worcester, Mass.

Hack Saws.
Niles-Bement-Pond Co., New York.

Hammers, Electric.
Helwig Mfg. Co., St. Paul.
Northern Elec. Mfg. Co., Madison.

Heating and Ventilating Apparatus.
American Blower Co., Detroit.
Buffalo Forge Co., Buffalo.
Crane Estate, M. H., Chicago.
Green Fuel Economizer Co., Matteawan, N. Y.
Hitchings & Co., New York.
Lord & Burnham Co., Irvington-on-Hudson, N. Y.
Simmons Co., John, New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Walworth Mfg. Co., Boston.
Western Electric Co., Chicago.
Wing Mfg. Co., L. J., New York.

Heating Installations (Screens for).
Harrington & King Perforating Co., Chicago.

Hogs or Edging Grinders.
Mitts & Merrill, Saginaw, Mich.

Hoisting Engines and Mchy.
Brown Hoisting Mchy. Co., Cleveland.
Bruce-Macbeth Engine Co., Ohio.
Carlin's Sons Co., Thomas, Pittsburg.
Dobbie Foundry & Machine Co., Niagara Falls.
Flory Mfg. Co., S., Bangor, Pa.
Foos Gas Engine Co., Springfield, O.
Hayward Co., New York
Industrial Works, Bay City, Mich.
Interstate Engng. Co., Cleveland, O.
Jeffrey Mfg. Co., Columbus.
Lambert Hoist. Eng. Co., Newark
Lidgerwood Mfg. Co., New York.
Link-Belt Company, Philadelphia, Pa.
Mead-Morrison Mfg. Co., Boston.
Mietz, August, New York.
Northern Engineering Works, Detroit.
Robins Conveying Belt Co., Passaic, N. J.
Sellers Co., Wm., Inc., Philadelphia.
Western Electric Co., Chicago.

Hoisting Rope.
American Mfg. Co., New York.

Hose.
Boston Belting Co., Boston.
Eureka Fire Hose Mfg. Co., N. Y.

Hydraulic Fittings.
McGowan Co., John H., Cincinnati, O.
Jno. Simmons Co., New York.
Tight Joint Co., New York.

Hydraulic Gauges.
American Steam Gauge & Valve Mfg. Co., Boston.
Bristol Co., Waterbury, Conn.
Industrial Inst. Co., Foxboro, Mass.

Hydraulic Jacks.
Dudgeon, Richard, New York.

Hydraulic Leather.
Rhoads & Sons, J. E., Philadelphia.

Hydraulic Machinery.
Goulds Mfg. Co., Seneca Falls, N. Y.
McGowan Co., John H., Cincinnati, O.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.
Wood & Co., R. D., Phila., Pa.

Hydraulic Presses.
McGowan Co., John H., Cincinnati, O.
Niles-Bement-Pond Co., New York.
Wood & Co., R. D., Phila., Pa.

Hydraulic Rams.
Pelton Water Wheel Co., San Francisco.
Power Specialty Co., New York.

Hydraulic Turbines.
Morris Co., I. P., Philadelphia.

Ice-Mak'g & Refriger. Mchy.
De La Vergne Machine Co., N. Y.
Roelker, H. B., New York.

India Oil Stones.
Norton Co., Worcester, Mass.

Indicators.
American Steam Gauge & Valve Mfg. Co., Boston.
Schaeffer & Budenberg Mfg. Co., Brooklyn.
Industrial Inst. Co., Foxboro, Mass.

Industrial Methods.
Baker-Vawter Co., Chicago.
Cooper & Co., John A., Chicago.

Industrial Railways.
Porter Co., H. K., Pittsburg.

Ingots.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.

Injectors.
Powell Co., Wm., Cincinnati.
Sellers & Co., Inc., Wm., Philadelphia.

Insulation, Electric.
Diamond State Fibre Co., Elsmere, Del.

Insurance.
Fidelity & Casualty Co., New York.

Internal Gearing.
Nuttall Co., R. D., Pittsburg.

Iron & Steel Tubular Poles.
Electric Railway Equipment Co., Cincinnati.

Jacks, Hydraulic.
Watson-Stillman Co., New York.

Keyseaters.
Mitts & Merrill, Saginaw, Mich.
Niles Bement Pond Co., New York.

Keyseat Milling Machine.
Mitts & Merrill, Saginaw, Mich
Niles Bement Pond Co., New York.

Laboratory Apparatus.
Bausch & Lomb Optical Co., Rochester,

Lace Leather.
Rhoads & Sons, J. E., Philadelphia.

Lamps, Electric.
Cooper-Hewitt Electric Co., New York.
Excello Arc Lamp Co., New York.
General Electric Co., New York.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Lathes.
American Tool Wks. Co., Cincinnati, Ohio.
Am. Tool & Mch. Co., Boston.
Barnes Co., W. F. & J., Rockford, Ill.
Jones & Lamson Mch. Co., Springfield, Vt.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford
Sellers Co., Wm., Inc., Philadelphia.

Leather Packing.
Rhoads & Sons, J. E., Philadelphia

Lifting Magnets.
Cutler Hammer Mfg. Co., Milwaukee
Elec. Controller & Mfg. Co., Cleveland.

Light Railways.
Link Belt Co., Philadelphia.
Robins Conveying Belt Co., Passaic N. J.

Lights, Floor & Sidewalk
Brooks & Co., T. H., Cleveland

Line Materials, Electric.
Electric Railway Equipment Co., Cincinnati.

Lockers, Steel.
Buffalo Wire Wks. Co., Buffalo, N. Y.
Durand-Steel Locker Co., Chicago.

Locomotive Cranes.
Beaumont & Co., R. H., Philadelphia
Brown Hoisting Mchy. Co., Cleveland
Industrial Works, Bay City, Mich.
Interstate Engng. Co., Cleveland, O.
Mead-Morrison Mfg. Co., Boston.
Northern Engineering Works, Detroit.

Locomotives.
Baldwin Locomotive Works, Phila.
General Electric Co., New York.
Jeffrey Mfg. Co., Columbus.
Porter Co., H. K., Pittsburg.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Logging Machinery.
Lidgerwood Mfg. Co., New York.

LooseLeaf Accounting Forms
Baker-Vawter Co., Chicago.

Lubricants.
Dixon Crucible Co., Jos., Jersey City.
Harris Oil Co., A. W., Providence, R. I.
Obermayer Co., S., Cincinnati.
Powell Co., Wm., Cincinnati
Williams Valve Co., D. T., Cincinnati.

Lubricators.
Detroit Lubricator Co., Detroit
Greene, Tweed & Co., New York.
Powell Co., Wm., Cincinnati.
Sterling Lubricator Co., Rochester.
Williams Valve Co., D. T., Cincinnati.

Machine Knives.
Mitts & Merrill, Saginaw, Mich.

Machinery Exhibits.
Bourse, Philadelphia.

Machinery, Second Hand.
Niles-Bement Pond Co., New York.

Machine Tools & Supplies.
Mitts & Merrill, Saginaw, Mich.

Machinists' Small Tools.
Pratt & Whitney Co., Hartford.

Magnesia Brick Cement.
Harbison-Walker Refactories Co., Pittsburg, Pa.

Magnesite.
Harbison Walker Refactories Co., Pittsburg, Pa.

Malleable Castings.
Jeffrey Mfg. Co., Columbus, O.

Marine Boilers.
Kouffel & Esser Co.,
Morris Co., I. P., Philadelphia.

Measuring Tapes.
Kolesch & Co., New York.

Metal Gaskets.
American Goetze-Gasket & Packing Co., New York.

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Metal Lath.
Buffalo Wire Wks. Co., Buffalo, N. Y.
Roebling Construction Co., N. Y.

Metallic Packing.
American Goetze Gasket Packing Co., New York.

Meters, Electric.
General Electric Co., New York.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Weston Elec. Inst. Co., Waverly Park, Newark, N. J.

Milling Machines.
Adams Co., Dubuque, Iowa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Sellers & Co., Inc., William, Phila.

Mill Supplies.
Dodge Mfg. Co., Mishawaka, Ind.
Powell Co., Wm., Cincinnati.
Robins Conveying Belt Co, Passaic, N J.
Williams Valve Co., D. T., Cincinnati.

Mine Cars.
Jeffrey Mfg. Co., Columbus.

Mining Machinery.
Bradley Pulverizing Co., Boston.
Brown Hoisting Mchy. Co., Cleveland.
Blake Mfg. Co., Geo. F., New York.
Crocker Wheeler Co., Ampere, N. J.
Deane Steam Pump Co., New York.
Dodge Mfg. Co., Mishawaka, Ind.
Farrell Fdy. & Mch. Co., Ansonia, Conn.
General Electric Co., New York.
Goulds Mfg. Co., Seneca Falls, N. Y.
Ingersoll-Rand Co., New York.
Jeanesville Iron Works Co., Hazleton, Pa.
Jeffrey Mfg. Co., Columbus.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., N. Y.
Lambert Hoist. Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.
McGowan Co., John H., Cincinnati.
Mead Morrison Mfg. Co., Boston.
Norwalk Iron Wks. Co., Norwalk, Ct.
Power Specialty Co., New York.
Robins Conveying Belt Co., Passaic, N. J.
Smidth & Co., F. L., New York.
Snow Steam Pump Wks., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Worthington, Henry R., New York.

Motors, Electric.
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Mfg. Co., Milwaukee.
General Electric Co., New York.
Jeffrey Mfg. Co., Columbus.
Northern Elec. Mfg. Co., Madison.
Sprague Electric Co., New York.
Stow Mfg. Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Motor Parts.
Electric Railway Equipment Co., Cincinnati.

Motors, Steam Turbine.
De Laval Steam Turbine Co., Trenton.

Moulding Machines.
Blake Mfg. Co., Geo. F., New York.
Obermayer Co., S., Cincinnati.
Power Specialty Co., New York.

Name Plates.
Schwerdtle Stamp Co., Bridgeport.

Naphtha Gas Machines.
Am. Gas Furnace Co., New York.

Nozzle Piezometer Gauge.
Amer. Steam Gauge & Valve Mfg. Co., Boston.

Ohmmeters.
Weston Elec. Instrument Co., Waverly Park, Newark, N. J.

Oil Burners.
Petroleum Iron Wks. Co., Sharon, Pa.

Oil and Grease Cups.
Williams Valve Co., D. T., Cincinnati.

Oil Engines.
De La Vergne Machine Co., N. Y.
Du Bois Iron Works, Du Bois, Pa.
Mietz, August, New York.
Moore & Sons Corp., Sam'l L., Elizabethport, N. J.

Oil—Lubricating.
Harris Oil Co., A. W., Providence, R. I.
Kellogg & Co., E. H., New York.

Oil Refining Plants.
Petroleum Iron Wks. Co., Sharon, Pa.

Oil Pumps.
Williams Valve Co., D. T., Cincinnati.
Wood & Co., R. D., Phila., Pa.

Oil Stones.
Carborundum Co., Niagara Falls, N. Y
Norton Co., Worcester, Mass.

Oil Tanks.
Graver Tank Works, Wm., East Chicago, Ind.
Wood & Co., R. D., Phila., Pa.
Wright Mfg. Co., Detroit.

Packing.
American Goetze-Gasket & Packing Co., New York.
Boston Belting Co., Boston,
Jenkins Bros., New York.

Paint Graphite.
Obermayer Co., S., Cincinnati.

Paints and Varnishes.
Dixon Crucible Co., Jos., Jersey City.
Lowe Bros., Dayton, Ohio.

Paper-Mill Machinery.
Blake Mfg. Co., Geo. F., New York.
Caldwell & Son Co., H. W., Chicago.
Deane Steam Pump Co., New York.
Dodge Mfg. Co., Mishawaka, Ind.
Goulds Mfg. Co., Seneca Falls, N. Y.
Jeffrey Mfg. Co., Columbus.
Keyes & Son, F. E., New York.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
Robins Conveying Belt Co., N. Y.
Snow Steam Pump Wks., New York.
Worthington, Henry R., New York.

Patent Attorneys.
Dieterich, C. A., New York.
Evans, Wilkins & Co., Washington, D. C.
Macdonald & Macdonald, New York.
Pannett, Ben B., Ontario, Canada.
Weeks, Edw. M., Washington, D. C.

Pattern Makers.
Buffalo Gear & Pattern Wks., Buffalo.

Pattern-Bakers' Machinery.
Fay & Egan Co., Cincinnati.
Pratt & Whitney Co., Hartford.

Pavement Filler.
Barrett Mfg. Co., New York.

Penstocks.
Atlantic Works, East Boston, Mass.
Graver Tank Works, Wm., East Chicago, Ind.
Petroleum Iron Wks., Wm., East Chi
Walsh's Holyoke Steam Boiler Co., Holyoke, Mass.

Perforated Metal.
Caldwell & Son Co., H. W., Chicago.
Harrington & King Perforating Co., Chicago.

Photographic Lenses.
Bausch & Lomb Optical Co., Rochester.

Phosphor Bronze.
Phosphor Bronze Smelt. Co., Phila.
Poole Eng'g & Mch. Co., Baltimore.

Pile Drivers.
Ingersoll-Rand Co., New York.
Interstate Engng. Co., Cleveland, O.

Pinions.
New Process Raw Hide Co., Syracuse.

Pipe.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
Crane Estate, M. H., Chicago.
Fox & Co., Jno., New York.
Jno. Simmons Co., New York.
Koven & Bro., L. O., New York.
Petroleum Iron Wks. Co., Sharon, Pa.
Riter-Conley Mfg. Co., Pittsburg.
Scaife & Sons Co., Wm. B., Pittsburg.
U. S. Cast Iron Pipe & Fdy. Co., New York.
Walworth Mfg. Co., Boston.
Whitlock Coil Pipe Co., Hartford.
Williams & Co., J. H., Brooklyn, N. Y.
Wood & Co., R. D., Phila., Pa.
Wyckoff & Sons Co., A., Elmira, N. Y.

Pipe Bends.
Jno. Simmons Co., New York.
National Pipe Bending Co., New Haven.
Walworth Mfg. Co., Boston.
Whitlock Coil Pipe Co., Hartford.

Pipe-Cutting and Threading Machines.
Armstrong Mfg. Co., Bridgeport, Conn.
Cox & Sons Co., Bridgeton, N. J.
Hollands Mfg. Co., Erie, Pa.
Niles-Bement-Pond Co., New York.
Saunders' Sons, Inc., D., Yonkers.
Walworth Mfg. Co., Boston.

Pipe—Spiral Riveted.
Abendroth & Root Mfg. Co., Newburgh, N. Y.

Pipe Fittings, Cast Iron.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
Direct Separator Co., Syracuse, N. Y.
Pelton Water Wheel Co., San Francisco.
Pittsburg Valve & Fittings Co., Barberton, O.
Simmons Co., John, New York.
Walworth Mfg. Co., Boston.
Wood & Co., R. D., Phila., Pa.

Pipe Taps & Reamers.
Hollands Mfg. Co., Erie, Pa.

Pipe, Wood.
Wyckoff & Sons Co., A., Elmira, N. Y.

Piping Contractors.
Crane Estate, M. H., Chicago.

Pitch.
Barrett Mfg. Co., New York.

Planers.
American Tool Wks. Co., Cincinnati, Ohio.
Niles-Bement-Pond Co., New York.
Sellers & Co., William, Phila.

Planing Mill Machinery.
Fay & Egan Co., J. A., Cincinnati.

Pneumatic Tools.
American Compressor & Pump Wks., New York.
Clayton Air Compress. Wks., N. Y.
Curtis & Co. Mfg. Co., St. Louis.
Helwig Mfg. Co., St. Paul.
Ingersoll-Rand Co., New York.

Poles, Iron and Steel Tubular.
Electric Railway Equipment Co., Cincinnati.

Polishing Blocks & Wheels.
Carborundum Co., Niagara Falls, N. Y.
Norton Co., Worcester, Mass.

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Pop Safety Valves.
American Steam Gauge & Valve Mfg. Co., Boston.
McGowan Co., John H., Cincinnati, O
Powell Co., Wm., Cincinanti.

Portable Drilling Machines.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Portland Cement.
See Cement.

Powder—Blasting.
Sinnamahoning Powder Co., Emporium, Pa.

Powder Mixers.
Dunning, W. D., Syracuse.

Power-Transmission Mchy. .
Almond Mfg. Co., Ashburnham, Mass.
American Pulley Co., Philadelphia.
Brown Hoisting Mchy. Co., Cleveland.
Caldwell & Son Co., H. W., Chicago.
Crocker-Wheeler Co., Ampere, N. J.
Dodge Mfg. Co., Mishawaka, Ind.
General Electric Co., New York.
Hayward Co., The, New York.
Jeffrey Mfg. Co., Columbus.
Link-Belt Co., Philadelphia.
Mead-Morrison Mfg. Co., Boston.
Morse Chain Co., Ithaca, N. Y.
Northern Electric Mfg. Co., Madison.
Philips Pressed Steel Pulley Works, Philadelphia.
Robins Conveying Belt Co., Passaic, N. J.
Rockwood Mfg. Co., Indianapolis.
Sellers & Co., Inc., William, Phila.
Webster Mfg. Co., Chicago.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Wood & Co., R. D., Philadelphia.

Pressed Steel Pulleys.
American Pulley Co., Philadelphia.

Presses and Dies.
Armstrong Mfg. Co., Bridgeport, Ct.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Watson-Stillman Co., New York.
Wood & Co., R. D., Phila., Pa.

Prospecting Drills.
Ingersoll-Rand Co., New York.
Terry Core Drill Co., New York.

Pulleys, Shafting & Hangers
Am. Tool & Machine Co., Boston.
American Pulley Co., Philadelphia.
Caldwell & Son Co., H. W., Chicago.
Dodge Mfg. Co., Mishawaka, Ind.
Fay & Egan Co., Cincinnati.
Jeffrey Mfg. Co., Columbus, O.
Poole Eng'g & Mch. Co., Baltimore.
Robins Conveying Belt Co., Passaic, N. J.
Sellers & Co., Wm., Philadelphia.

Pulleys, Wrought Steel.
American Pulley Co., Philadelphia.
Philips Pressed Steel Pulley Works, Philadelphia.

Pulverizing Mills.
Dunning, W. D., Syracuse.
Lehigh Car, Wheel & Axle Works, Catasaqua, Pa.

Pump Governors.
Mason Regulator Co., Boston.
McGowan Co., John H., Cincinnati, O.

Pumping Engines.
McGowan Co., John H., Cincinnati, O

Pumps and Pumping Machy.
Alberger Condenser Co., New York.
American Compressor & Pump Works, New York.
Blake Mfg. Co., Geo. F., New York.
Buffalo Forge Co., Buffalo.
Cameron Steam Pump Works, N. Y.
Carlin's Sons Co., Thomas, Pittsburg.
Clayton Air Compress. Works, N. Y.
Deane Steam Pump Co., New York.
De Laval Steam Turbine Co., Trenton.
De La Vergne Mach Co., New York.
Deming Co., Salem, Ohio.
Du Bois Iron Works, Du Bois, Pa.
Goulds Mfg. Co., Seneca Falls, N. Y.
Holly Mfg. Co., New York.
Hooker Steam Pump Co., St. Louis.
Ingersoll-Rand Co., New York.
Jeancsville Iron Works Co., Hazleton, Pa.
Knowles Steam Pump Works, N. Y.
Pelton Water Wheel Co., Oakland, Cal.
Laidlaw-Dunn-Gordon Co., New York.
Lawrence Pump & Engine Co., Lawrence, Mass.
McGowan Co., John H., Cincinnati.
Mietz, August, New York.
Morris Co., I. P., Philadelphia.
Morris Machine Works, Baldwinsville, N. Y.
Snow Steam Pump Works, New York.
Watson-Stillman Co., New York.
Wheeler Condenser & Eng'g Co., Carteret, N. J.
Wood & Co., R. D., Phila., Pa.
Worthington, Henry R., New York.

Pump Pressure Regulator.
Davis Co., John, Chicago.
D'Este Co., Julian, Boston.
Mason Regulator Co., Boston.

Pumps, Syphon.
McGowan Co., John H., Cincinnati, O.

Punching & Shearing Mchy.
Buffalo Forge Co., Buffalo.
Morgan Construction Co., Worcester.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., William, Phila.
Wood & Co., R. D., Philadelphia.

Pyrometers.
Amer. Steam Gauge & Valve Mfg. Co., Boston.
Bristol Co., Waterbury, Conn.
Engelhard, Charles, New York.
Queen & Co., Philadelphia.
Schaeffer & Budenberg Mfg. Co., Brooklyn.

Quarry Machinery.
Brown Hoisting Mchy Co., Cleveland.
Flory Mfg. Co., S., Bangor, Pa.
Ingersoll-Rand Co., New York.
Lambert Hoist, Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
McGowan Co., John H., Cincinnati.
Mead-Morrison Mfg. Co., Boston.
Northern Engineering Works, Dertolt.
Robins Conveying Belt Co., Passaic, N. J.

Quartz Glass.
Engelhard, Charles, New York.

Racks—Machine Cut.
Nuttall Co., R. D., Pittsburg.

Rail Braces.
Rail Joint Co., New York.

Railings.
Anchor Post Iron Works, New York.

Rail Joints.
Rail Joint Co., New York.

Railway Shop Machinery.
Brown Hoisting Mchy. Co., Cleveland.
Clayton Air Compress. Works, N. Y.
Dodge Mfg. Co., Mishawaka, Ind.
Fay & Egan Co., Cincinnati.
Laidlaw-Dunn-Gordon Co., New York.
Niles-Bement-Pond Co., New York.
Norwalk Iron Works, So. Norwalk, Ct.
Pratt & Whitney Co., Hartford.
Sellers & Co., Inc., William, Phila.
Stow Flexible Shaft Co., Philadelphia.
Stow Mfg. Co., Binghamton, N. Y.

Rawhide Gears.
New Process Raw Hide Co., Syracuse.
Phila. Gear Works, Inc., Philadelphia.

Razor Hones.
Carborundum Co., Niagara Falls, N. Y.

Ready Roofing.
Barrett Mfg. Co., New York.

Reamers.
Ingersoll-Rand Co., New York.
Pratt & Whitney Co., Hartford.

Reinforced Concrete Steel.
Buffalo Wire Wks. Co., Buffalo, N. Y.
Roebling Construction Co., New York.

Relief Valves.
Davis Co., John, Chicago.

Resistance Banks and Units.
Elec. Controller & Mfg. Co., Cleveland.

Rheostats.
Cutler-Hammer Mfg. Co., Milwaukee.
Simplex Elec. Heat Co., Cambridge, Mass.

Rheostat Regulator.
Mason Regulator Co., Boston.

Riveting Machines.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Sellers Co., Wm., Inc., Phila.
Wood & Co., R. D., Phila., Pa.

Rock Breakers.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., Passaic, N. J.

Rolling Doors, Steel, Wood, Bronze.
Wilson Co., Jas. C., New York.

Rolling Mill Machinery.
Carlin's Sons Co., Thomas, Pittsburg.
Crocker-Wheeler Co., Ampere, N. J.
Dodge Mfg. Co., Mishawaka, Ind.
Farrell Fdy. & Mch. Co., Ansonia, Conn.
Morgan Construction Co., Worcester.
Niles-Bement-Pond Co., New York.
Poole Eng'g & Mch. Co., Baltimore.
Robins Conveying Belt Co., Passaic, N. J.

Roofing.
Barber Asphalt Paving Co., Phila.
Bird & Co., J. A. & W., Boston, Mass.
Barrett Mfg. Co., New York.

Roofing Materials.
Barrett Mfg. Co., New York

Rope.
American Mfg. Co., New York.

Rope Transmission.
American Mfg. Co., New York.
Caldwell & Son Co., H. W., Chicago.
Dodge Mfg. Co., Mishawaka, Ind.
Jeffrey Mfg. Co., Columbus.
Link-Belt Company, Philadelphia, Pa.
Phosphor Bronze Smelting Co., Philadelphia.

Rubber Goods.
Boston Belting Co., Boston.
Jenkins Bros., New York.

Rubbing and Sharpening Stones.
Norton Co., Worcester.

Sand Mixers and Sifters.
Link-Belt Company, Philadelphia, Pa.
Obermayer Co., S., Cincinnati.
Sellers & Co., William, Phila.

Sash Operating Device.
Hitchings & Co., New York.
Lord & Burnham Co., Irvington-on-Hudson, N. Y.

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Saw-Mill Machinery.
Curtis & Co. Mfg. Co., St. Louis.
Dodge Mfg. Co., Mishawaka, Ind.
Fay & Egan Co., J. A., Cincinnati.
Jeffrey Mfg. Co., Columbus.
Mitts & Merrill, Saginaw, Mich.

Saws, Hack.
Niles-Bement-Pond Co., New York.

Scales.
Richardson Scale Co., New York.

Screens, Mining.
Buffalo Wire Works Co., Buffalo.
Jeffrey Mfg. Co., Columbus.
Link Belt Company, Philadelphia, Pa.
Ludlow-Saylor Wire Co., St. Louis.

Screens, Rolled Slot.
Ludlow-Saylor Wire Co., St. Louis.

Screw Machines.
Jones & Lamson Mch. Co., Springfield, Va.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

Screw Plates.
Card Mfg. Co., S. W., Mansfield, Mass.

Separators, Pneumatic.
Sturtevant Co., B. F., Hyde Park, Mass.

Separators, Steam and Oil.
American Tool & Mch. Co., Boston.
Austin Separator Co., Detroit.
D'Este Co., Julian, Boston.
Direct Separator Co., Syracuse.
Goubert Mfg. Co., New York.
Harrison Safety Boiler Wks., Phila.
Hoppes Mfg. Co., Springfield O.
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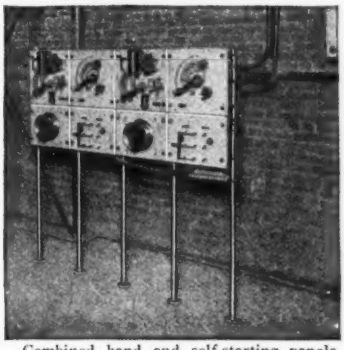

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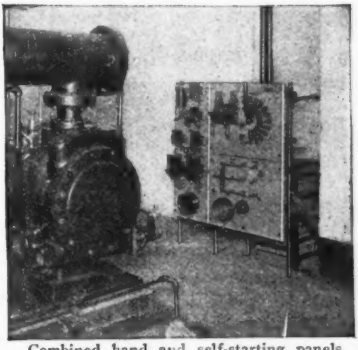

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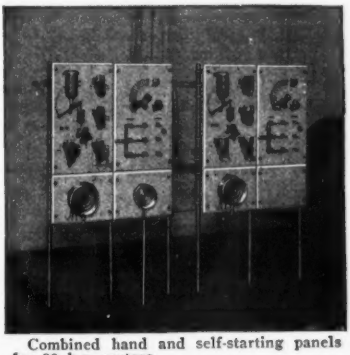

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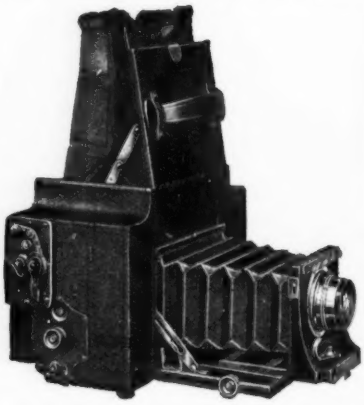

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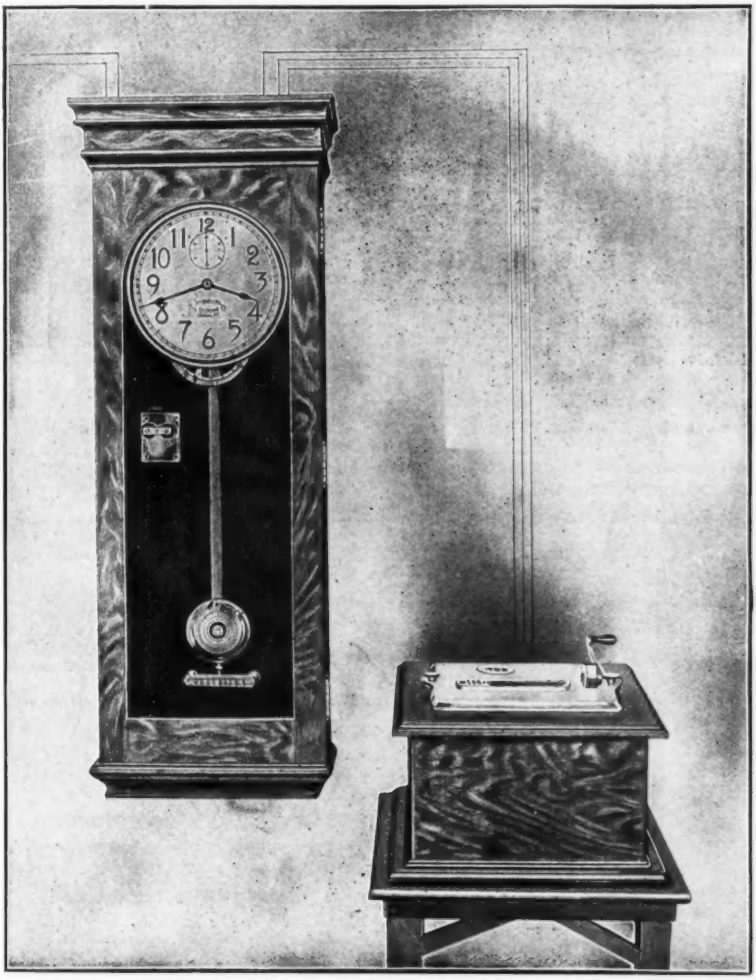

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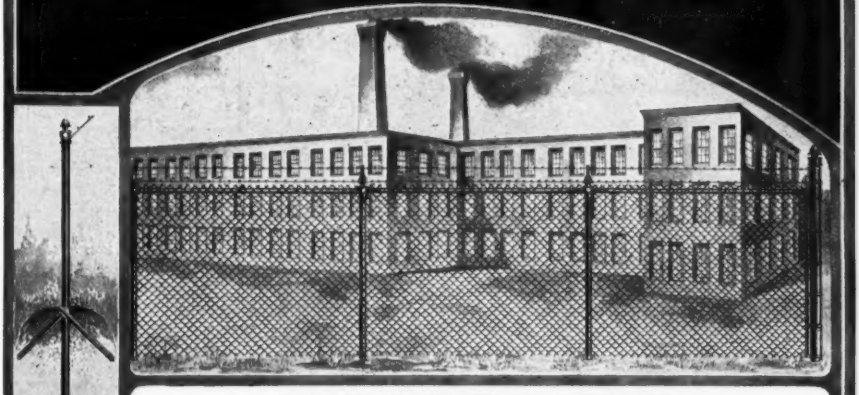

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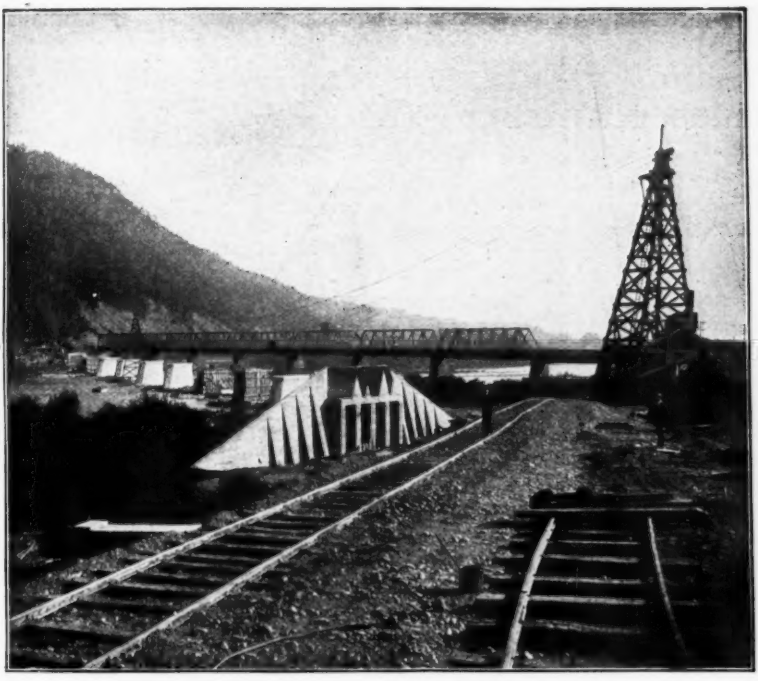

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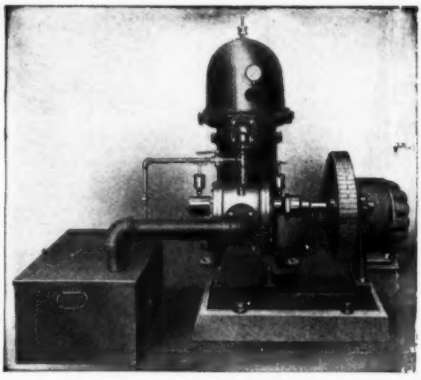

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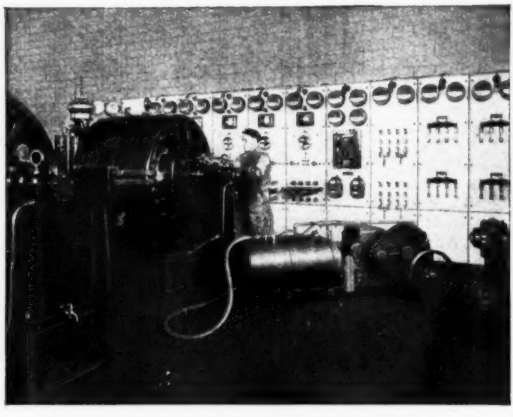

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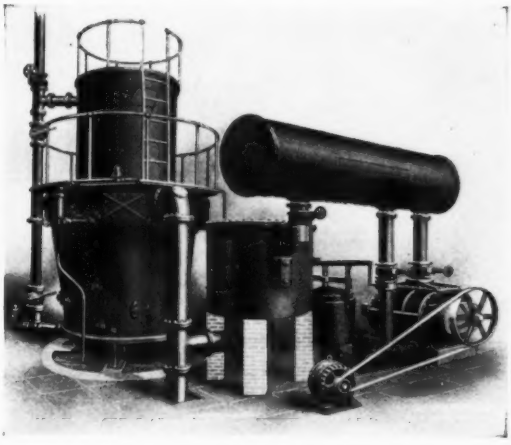

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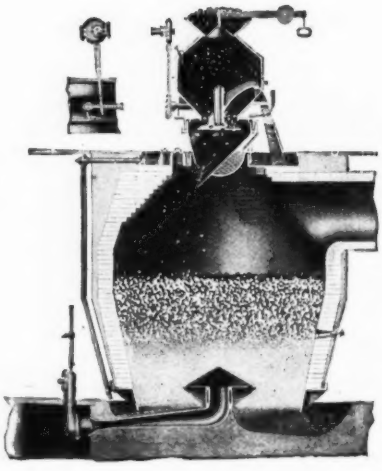

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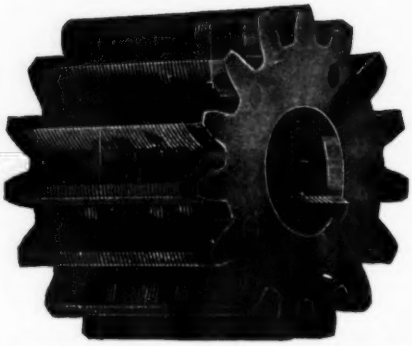

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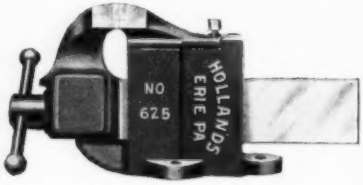

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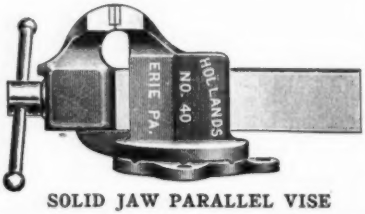

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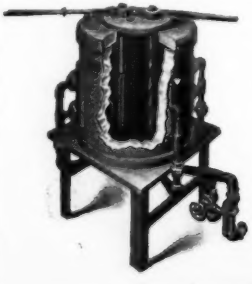

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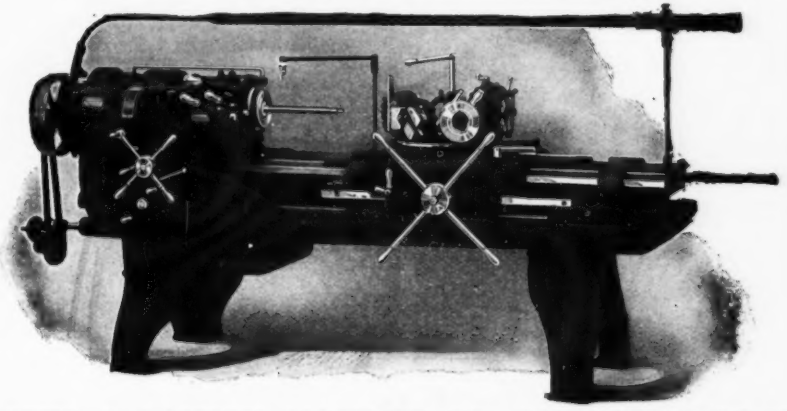

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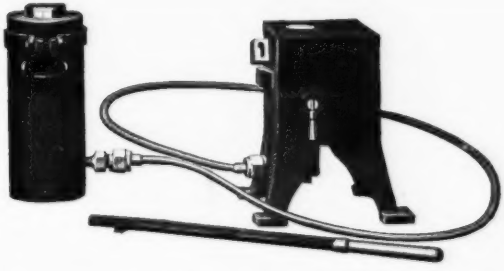

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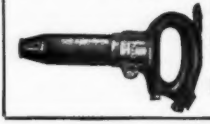

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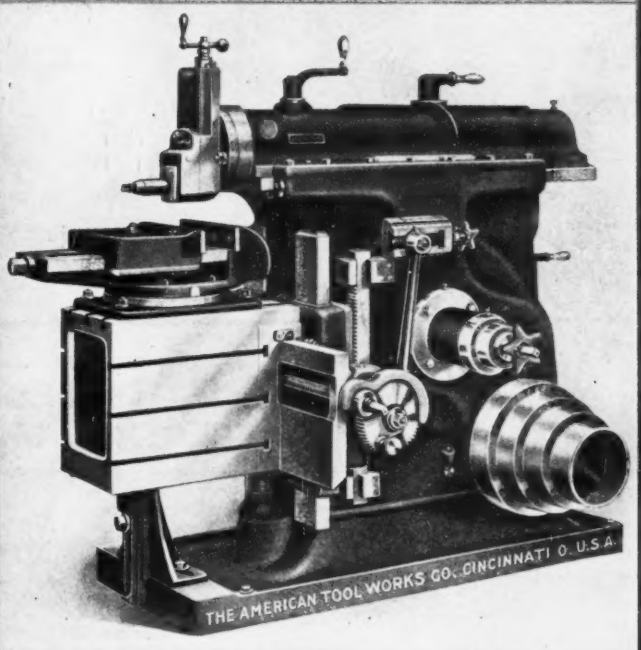

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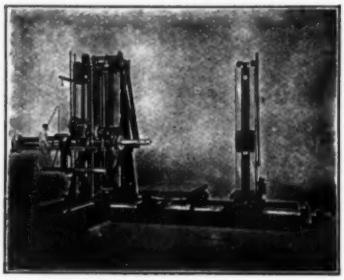

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Every imaginable speed between highest and lowest points.
Full rated H. P. at all speeds.
Only one voltage required to operate.
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Write for our No. 52 Bulletin, it tells all about it.

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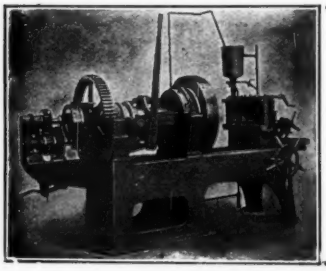

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in your lighting system is the **lamp.** The enclosed arc lamp **wastes 99%** of the power put into it.

Do you want to strengthen the **weak link 800%?**

The Excello Flaming Arc Lamp produces 6 to 10 times as much light as the enclosed arc with the **same power input.**

If you have a badly overloaded lighting generator, and still need more light, you can save the cost of a new generator installation by using Excello lamps to cut down the load.

Every Excello lamp **saves** from 1¼ to 1½ K-W in generator capacity. This means a saving from $100 to $125 in equipment investment alone, leaving the **coal saving** out of the question.

If you want **proof,** ask us. We can refer you to plenty of the biggest concerns in the country who have been proving it to their own satisfaction every day in the year for the last three years.

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The Cutting Face of a Grinding Wheel

has thousands of little tools cutting off little chips.

It makes a big difference what these little tools are made of just as it makes a big difference what quality of steel is used in making steel tools.

It makes a big difference as to how each little tool holds its cutting edge.

A Norton wheel gets its good-cutting face from Alundum.

Each little grain of Alundum that is working is a tool in perfect condition for good work.

The combination of Alundum and Norton wheel construction is such that each little cutting point is discarded as quickly as it cannot do the full amount of work expected of it, and a new cutting point or a new tool takes its place.

Insist on a grinding wheel made of Alundum, just as you would insist on the best grade of steel for your steel tools.

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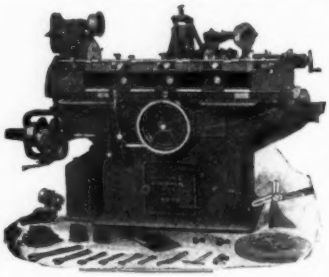

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Making Time in Your Grinding Department

This depends on your grinding equipment.

Make it a "LANDIS" one and we can foretell you the results.

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TAKE THE TOOL TO THE WORK

Save the time otherwise lost in taking machinery apart and mounting it on lathes or drill presses. With the STOW FLEXIBLE SHAFT and portable motor, *Steam, Electric* or *Pneumatic*, your *drilling, tapping, reaming, grinding*, etc., will be accomplished quickly and accurately.

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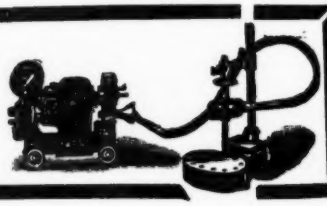

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Consult the Engineering Index in this number.

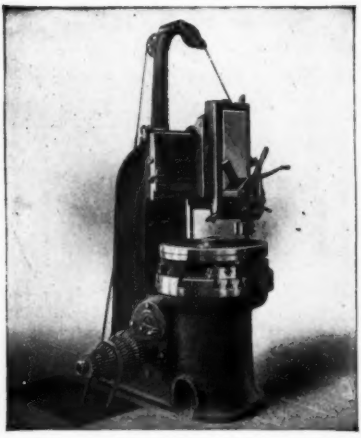
Prosperity is here—
It's going to be a question of meeting the demands this fall—let

Carborundum Grinding Wheels

increase the output of your plant—and **decrease** the cost of production —they'll do it.

The Carborundum Company

Niagara Falls, N. Y.



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reduce the friction and wear of the joint to a minimum, and provides a power transmitter having an efficiency of 99%.

Morse Chains are particularly desirable where a large amount of power is to be transmitted or where a compact, durable, efficient transmission, giving a large and speed ratio, is required.

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STEAM HAMMERS

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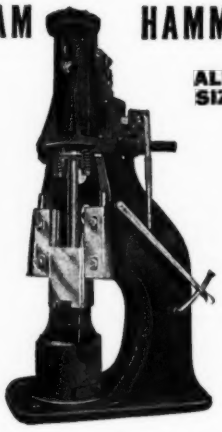

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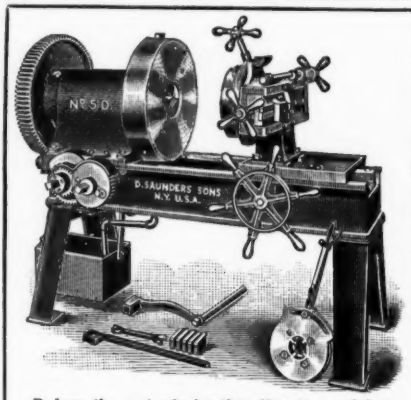

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Complete in all details, and are adapted to a very large range of work. Cut illustrates our No. 5 D Machine. Capacity, 1 to 6 inches.
Catalogue fully describing these machines will be sent free on request.

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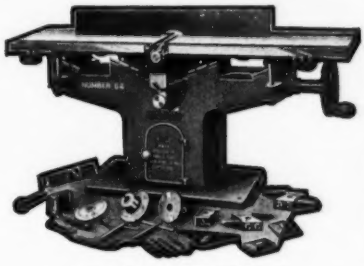

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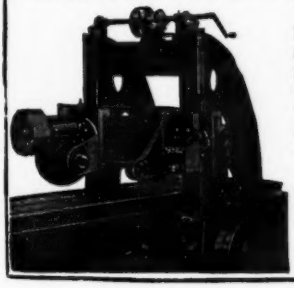

The Farwell Miller can be attached to any planer and operated with vertical, horizontal or angular spindle.

Four sizes.

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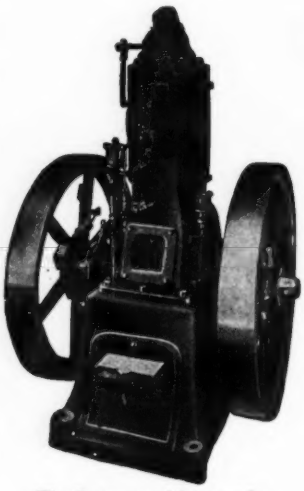

The first successful two-cycle fuel oil engine

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It is easy to start and operate—no batteries or spark devices. Absolute control without heavy fly wheel. Makes a successful electric light without cycle beat.

Write for full information.

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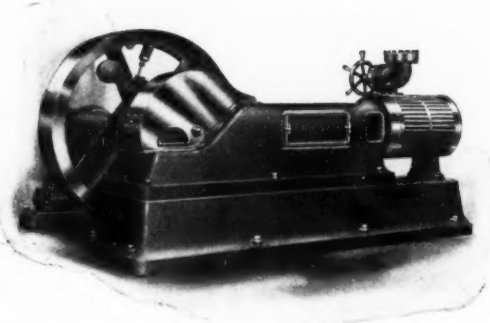

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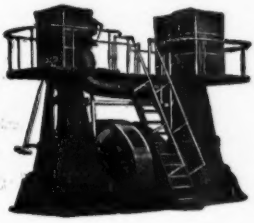

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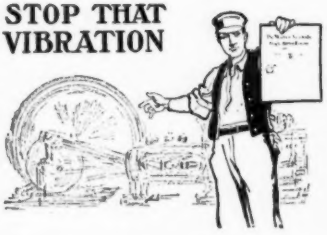

DON'T risk your engineering reputation by specifying for office, hospital and hotel use, or for that matter, for any class of service, an engine which sets up annoying vibrations. It is inherently impossible to balance a simple, high speed engine.

It will pay you to get our new pamphlet on the "Modern High Speed Engine," and learn of a high speed engine without high speed faults. By departing from established customs in building high speed engines we have evolved the

American Ball Angle Compound Engine

an engine which lends itself to perfect balancing.

How well these engines meet the requirements of quiet running and freedom from vibration is shown by the fact that in the case of a 160 H.P. direct-connected unit running at 300 R.P.M., resting on a common concrete foundation less than a foot thick and without a single bolt, an ordinary lead pencil will stand balanced on end on either the horizontal or vertical cylinder. This is a regular stock engine.

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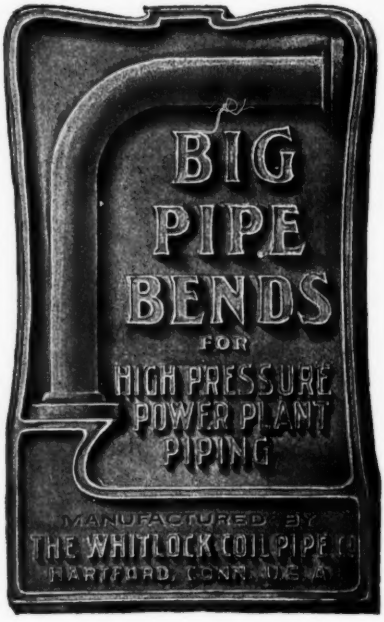
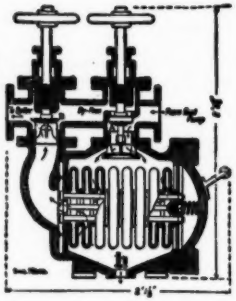
American Engine Co.

43 Raritan Ave. Bound Brook, N. J.



Keep Out Oil.



The function of this filter is to prevent oil getting into your boilers, and is used wherever a condenser is used.

It is extensively used both on land and sea.

Send for illustrated circular giving details and list of principal users.

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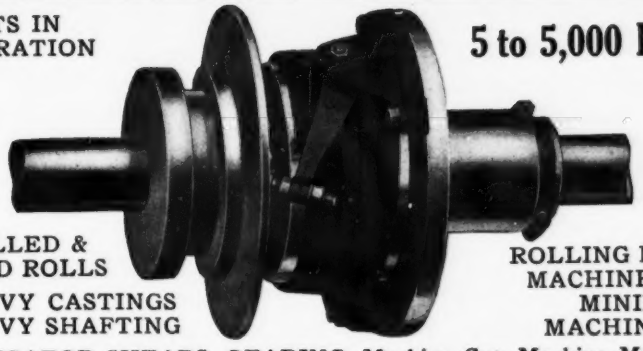

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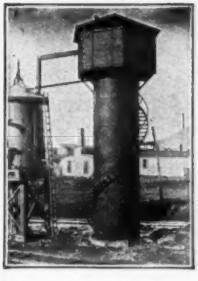

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"SIROCCO"

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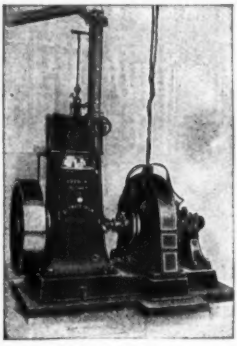

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have shown by actual test their capacity to produce a gratifying economy in the consumption of coal, water and oil. Our BULLETIN No. 10 fully tells the story. Again, economical boiler performance is largely a question of operation and firing, and the points of Engineering involved in the Stoker and Furnace design contribute largely toward a general increase of boiler efficiency of at least 20%.

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is designed to give just such results and has demonstrated its capacity to realize in practice the complete and smokeless combustion of soft coal. Our BULLETIN No. 20 describes and illustrates this equipment.

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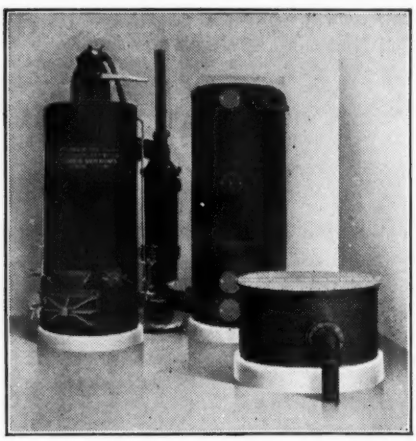

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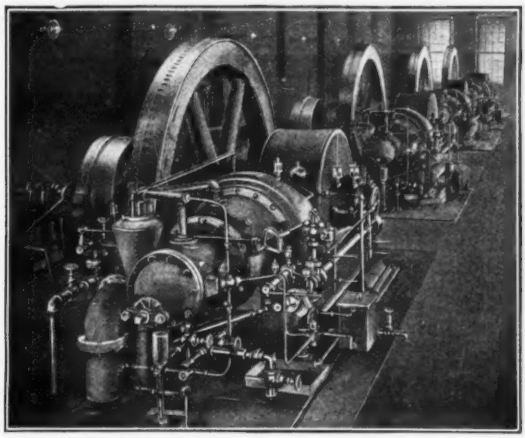

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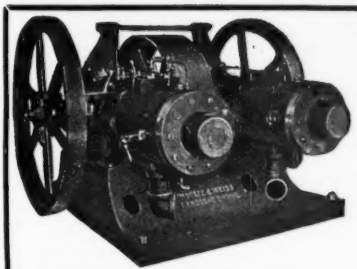

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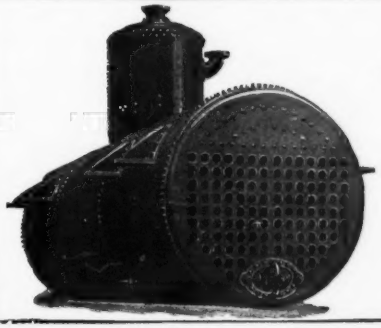

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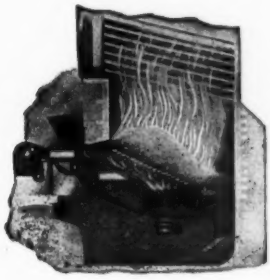

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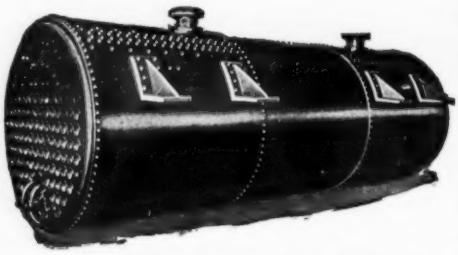

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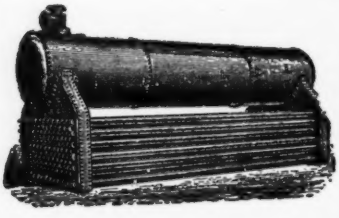

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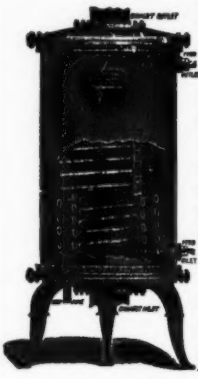

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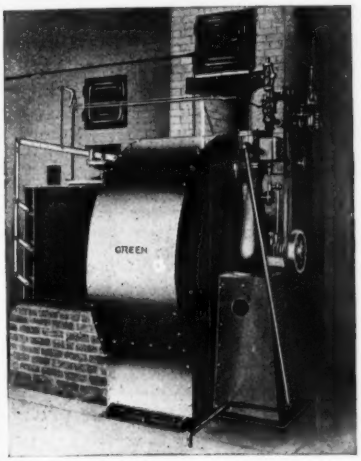

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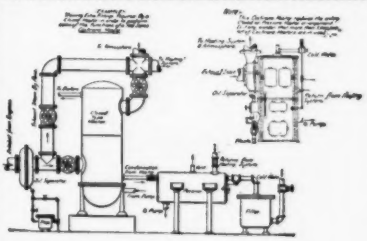

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2d, a trap to drain this separator.

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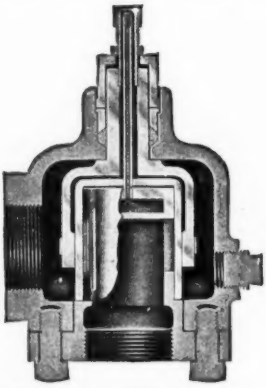

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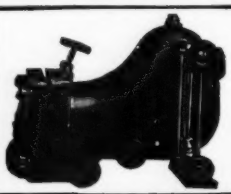

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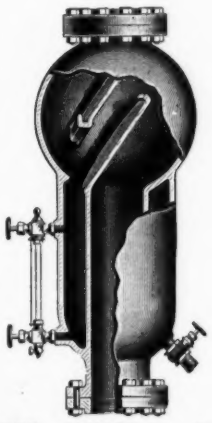

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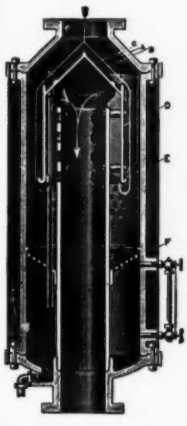

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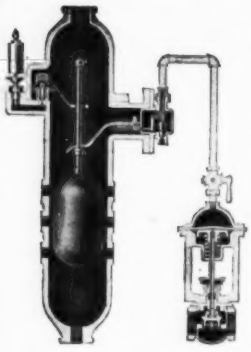

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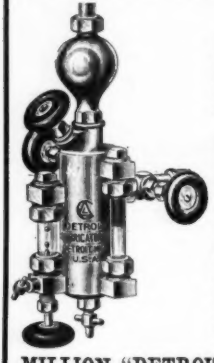

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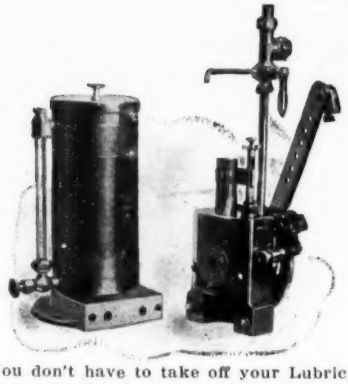

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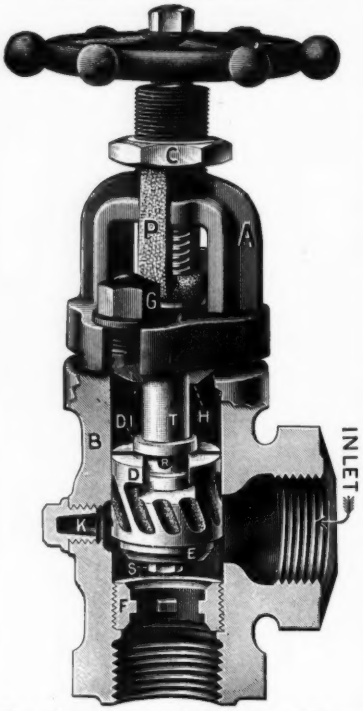

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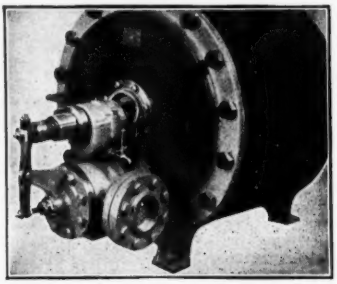

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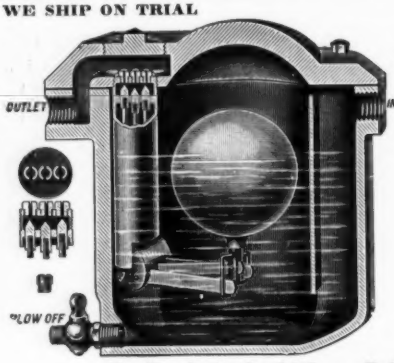

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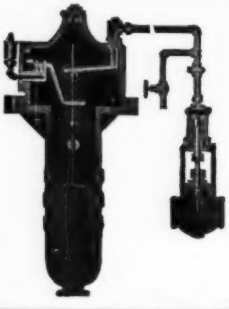

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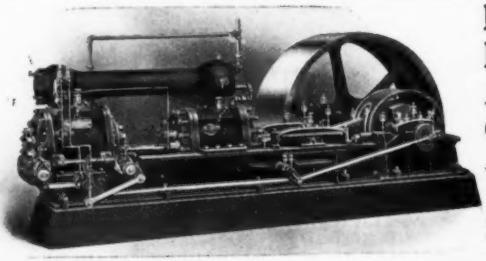

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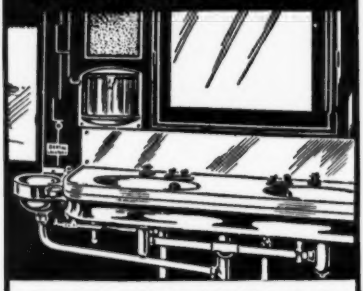

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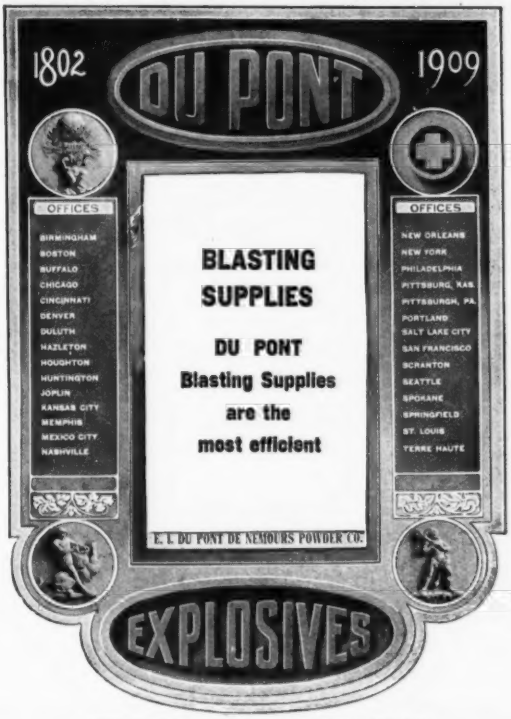

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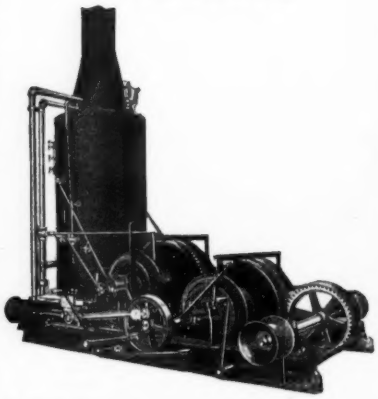

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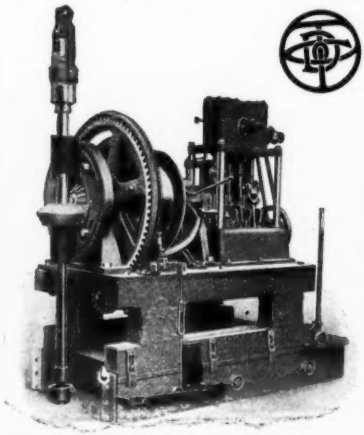

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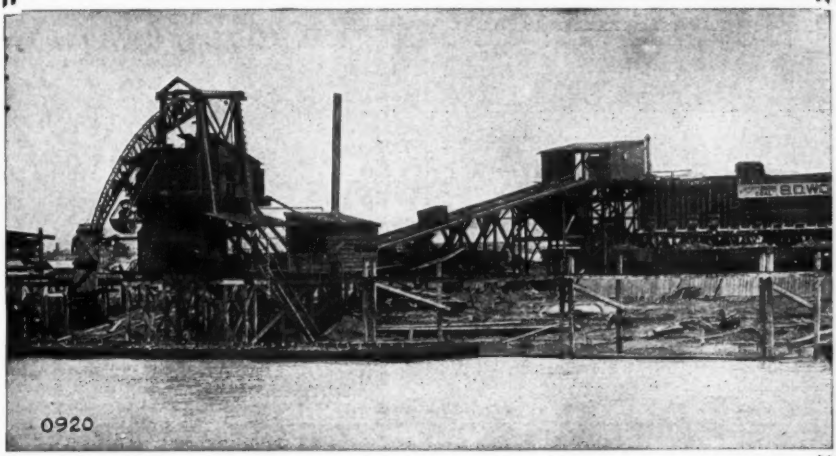

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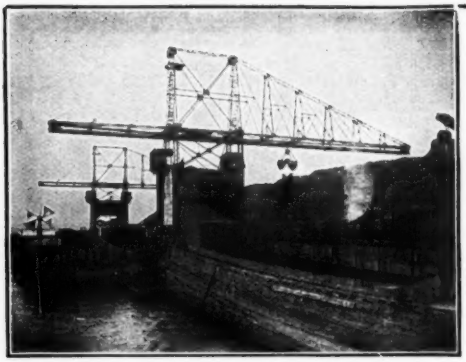

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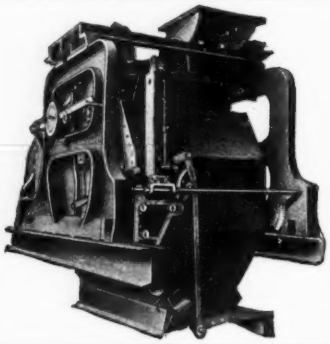

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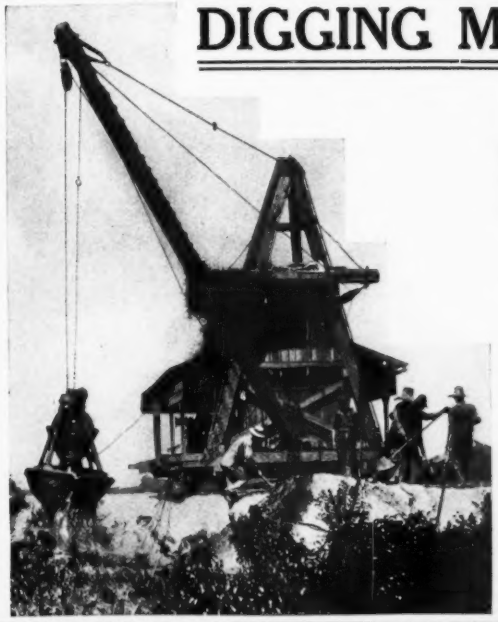

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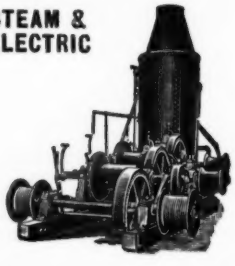

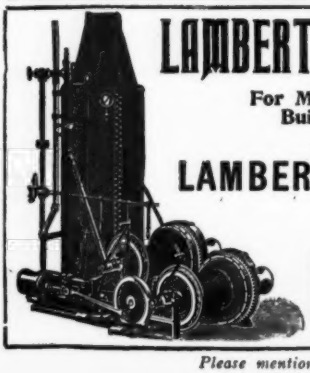

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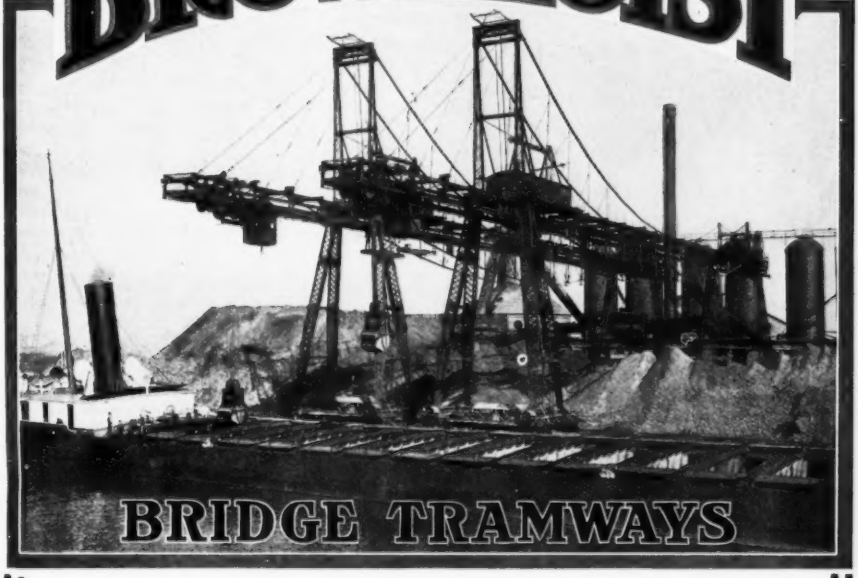

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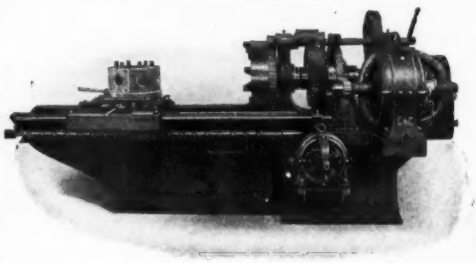

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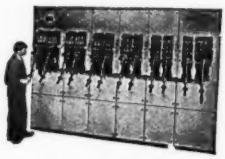

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Will increase the general efficiency of every plant in which they are installed.

Are of the same quality as our 4,000,000 "BELL" TELEPHONES now in use throughout the United States.

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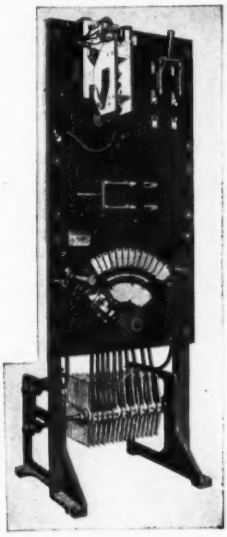
A LOW COST MOTOR STARTER FOR HARD SERVICE



The design of Motor Starters, or Rheostats, has not kept pace with the improvements in the design of motors.

In reality they have deteriorated, due to the willingness of manufacturers to cheapen their construction to meet competition, and this has been a "see-saw" process so that now it is agreed that, speaking broadly, the Motor Starter is not competent in hard work.

Managers and Superintendents who know their up-keep costs know that this charge against Motor Starters in hard work is excessive, and that the ordinary Motor Starter, although low in first cost, is very high priced in the long run. The ultimate cost of an article is the purchase price plus the up-keep charges during its useful life, and in the case of ordinary Motor Starters in hard work the up-keep charge is excessive compared with motors and the useful life very much shorter.

Type M Motor Starters are competent in hard service, and their ultimate cost is much less than low priced Motor Starters, while their useful life is as long as the best designed motor.

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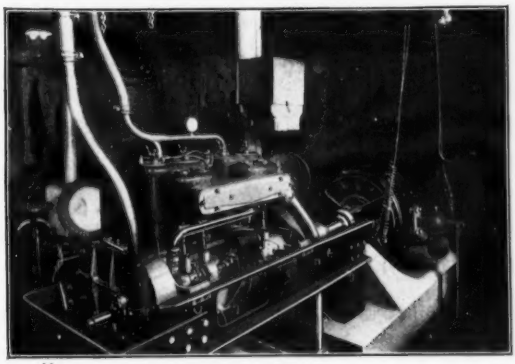

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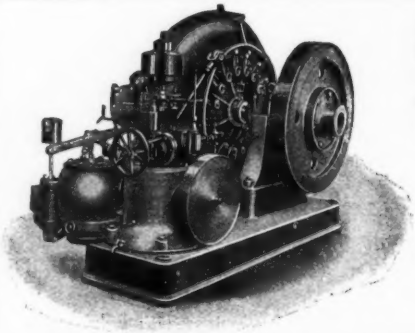

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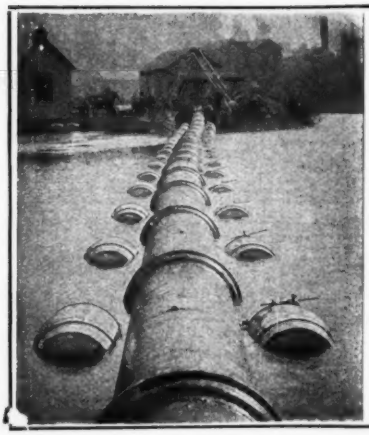

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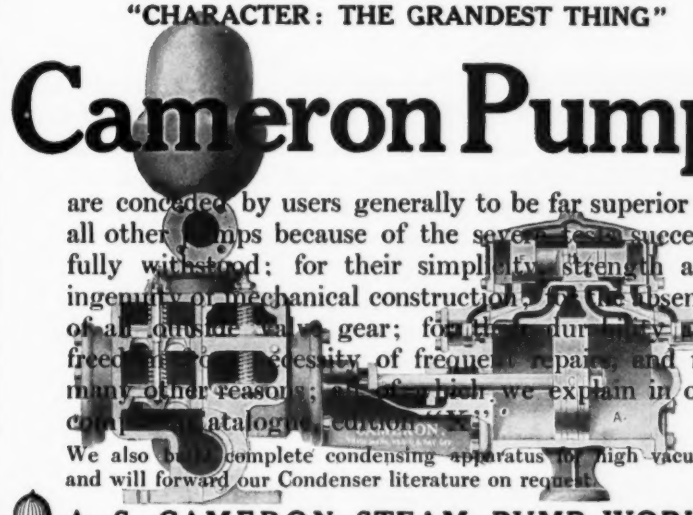
"CHARACTER: THE GRANDEST THING"

Cameron Pumps



are conceded by users generally to be far superior to all other pumps because of the severe tests successfully withstood; for their simplicity, strength and ingenuity of mechanical construction; for the absence of all outside valve gear; for their durability and freedom from necessity of frequent repairs, and for many other reasons; all of which we explain in our complete catalogue, Edition "X 39".

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DIRECT-ACTING, FLY WHEEL and CENTRIFUGAL
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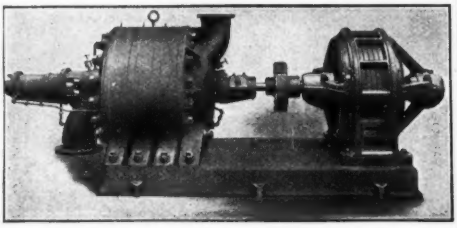

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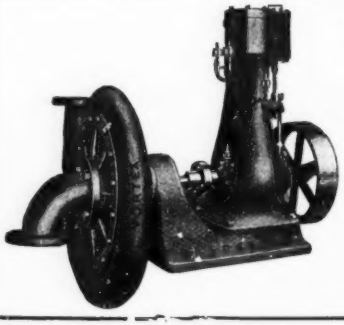

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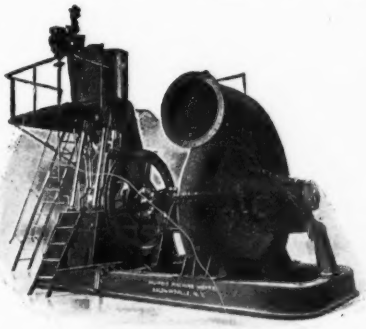

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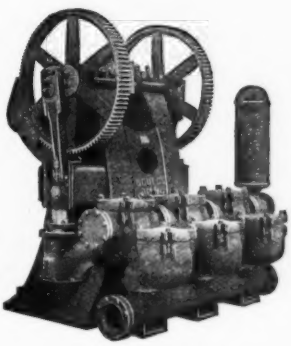

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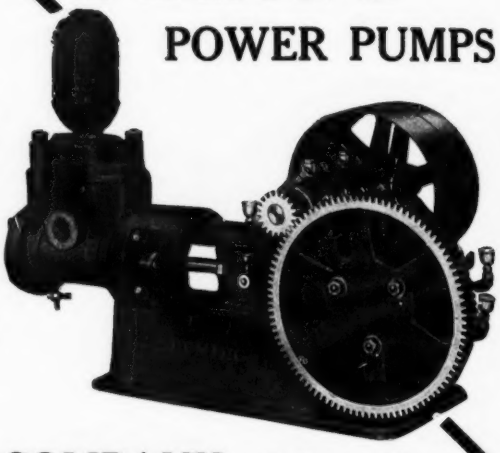

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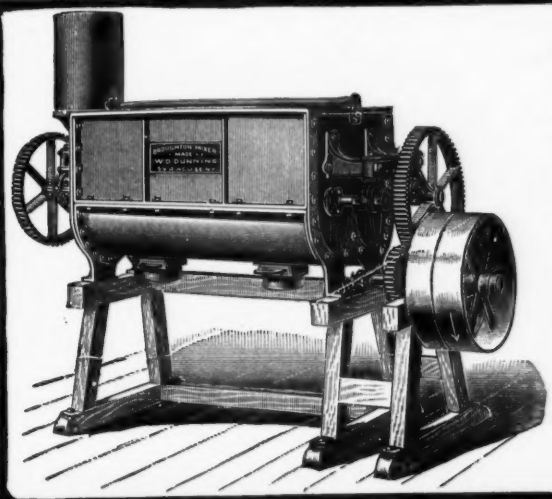

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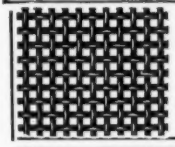

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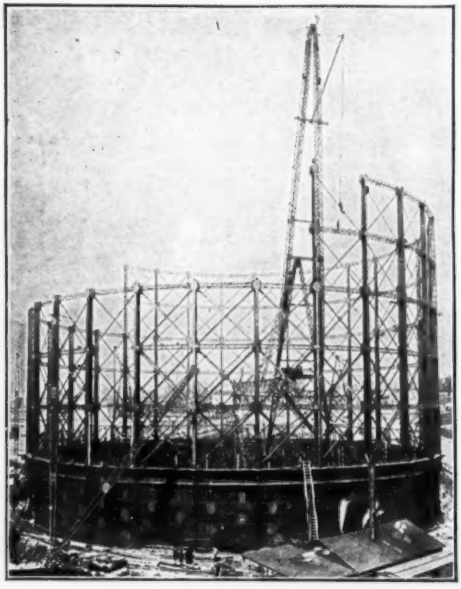

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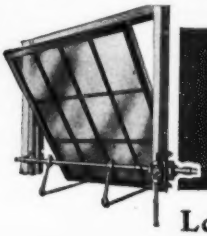

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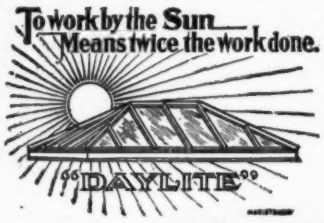

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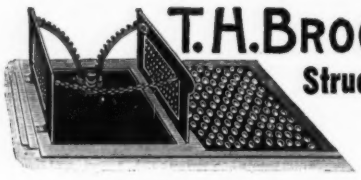

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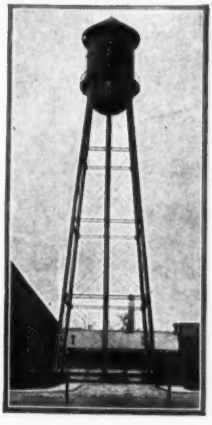

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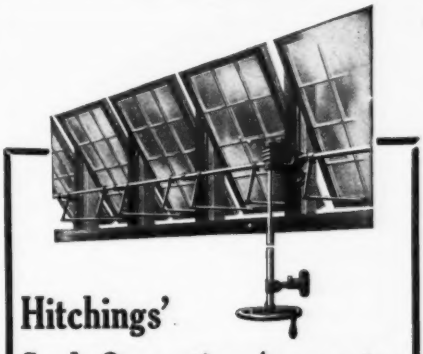

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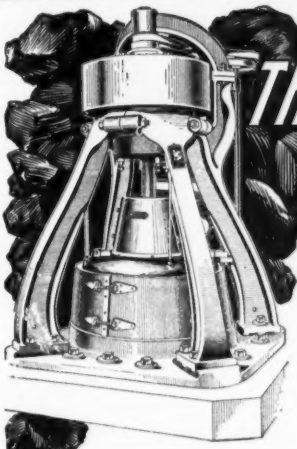

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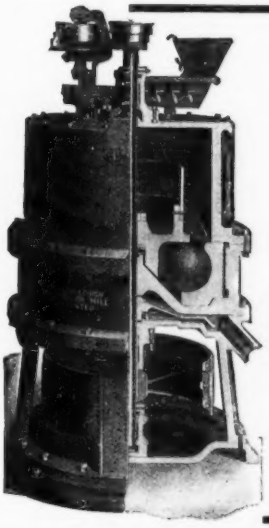

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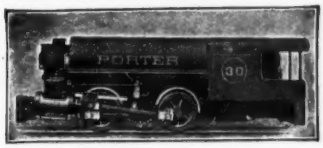

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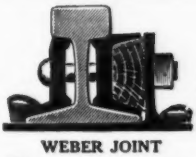

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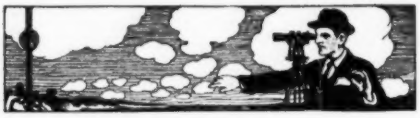

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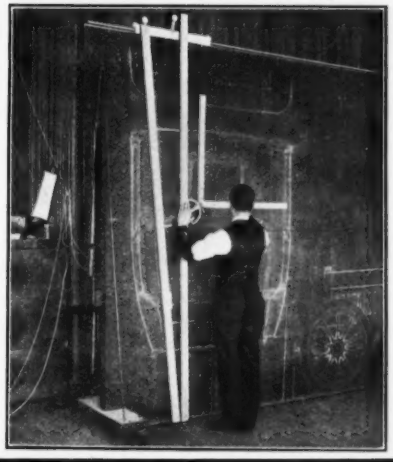

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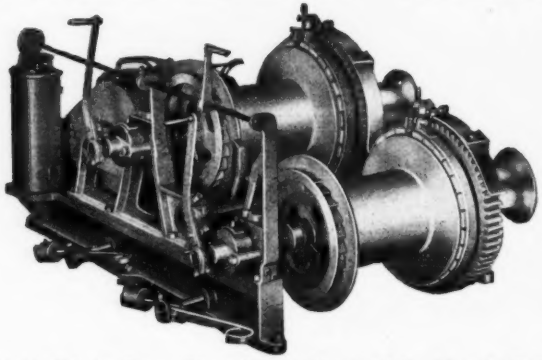

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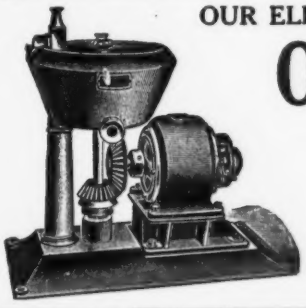

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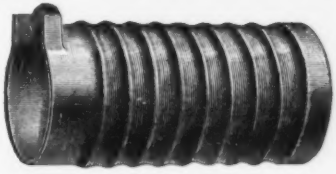

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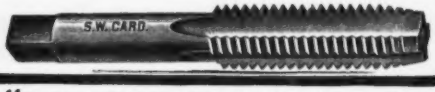

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